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Agriculture and Animal Husbandry in India

1933-34 & 1934-35

Part I.—Crop Production

Issued under the Authority
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PREFACE.

" Agriculture and Animal Husbandry in India " (formerly called the Review of Agricultural Operations in India) for 1933-35 (Part I) is based on the annual reports of the Departments of Agriculture of the Provinces and States and the ' Review of the Trade in India ' for these two years. Some provincial reports deal with the agricultural year ending in June, while others and the ' Review of the Trade in India ' deal with the fiscal year ending in March. The Review is issued in two parts. Part I deals with Crop Production and Part II with Animal Husbandry. A number of officers have contributed to this Review and their assistance has been acknowledged under the various chapters. It is proposed to publish this Review annually in future.

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Agriculture and Animal Husbandry in India, 1933-34 and 1934-35

Part I.—Crop Production.

CHAPTER I.

AGRICULTURAL CONDITIONS DURING 1933-34 AND 1934-35.

1. AGRICULTURAL AND CLIMATIC CONDITIONS.

1933-34

The monsoon of 1933 gave on the whole well-distributed rains over the country. There were no prolonged breaks and the rainfall was generally in excess of the normal. During the retreating period of the monsoon, rainfall was deficient in the Punjab, the North-West Frontier Province, Sind and North-East India; elsewhere it was at least normal. Taking the year as a whole, the total rainfall was higher than usual in most parts of the country.

From the agricultural point of view, the season was fairly good, although in some places crops were damaged by excessive rain and in the cold weather by low temperatures and frost. The outturn of rice fell short of the last year's good crop, but was still satisfactory, particularly in Burma. A very good yield was obtained from the sugarcane crop, which exceeded the previous year's record outturn by eight per cent. The total production of jute and cotton increased by thirteen and seven per cent. respectively, as compared with the preceding year. Groundnut gave an increased production in 1933-34, while sesamum and castor seeds yielded slightly less than in the preceding year. The wheat crop of 1932-33, most of which was moved during the year under review, was better than the preceding year by five per cent. The production of rape and mustard and linseed (winter oilseeds) of 1932-33 was about the same as in the preceding season.

MADRAS. The South-West Monsoon commenced early and was on the whole satisfactory and the North-East Monsoon was also bordering on the average but the rainfall was not very evenly distributed. A severe cyclone in December 1933 caused considerable damage in some of the east coast districts. The season for the Presidency as a whole was fairly satisfactory but was less favourable than in the previous year for all crops except *cholam* (*Sorghum vulgare*), sugarcane and cotton. There was a marked fall in the price of paddy, the most important staple food crop of this presidency.

BOMBAY. The season of 1933-34, though not as satisfactory as its predecessor, was on the whole fair, both in the presidency proper and Sind, notwithstanding the uneven distribution of rains and the cold spell which occurred in the northern part of the presidency during January 1934. In the Konkan, the season was slightly below normal, crops being affected either by deficient or excessive rainfall and later on by frost. In Gujarat the rainfall was sufficient and well distributed, but frost in February did damage. In the Deccan, the crops were normal but considerably affected by frost. In the Karnatak, the excessive rainfall in October and November, coupled with untimely rains in April, damaged both the wheat and cotton crops.

SIND. Rainfall was in most parts timely and well distributed except that heavy showers of rain in August damaged the newly transplanted rice crop in the Larkana District. The *kharif* (rainy) season was satisfactory and large areas came under *bosi* (unirrigated) crops in the *rabi* (winter) season, but the severe and prolonged period of frost between the 4th January and the 4th February 1934 caused damage to winter crops, especially those cultivated under *bosi* conditions.

BENGAL. Unfavourable seasonal influences existed in several parts of the province. Heavy floods caused local damage to paddy and jute crops. Taking the province as a whole, the season was satisfactory for winter crops and fair for autumn crops; the outturn was not below normal. There was a slight rise in the price of paddy, but the price of jute was lower than in the previous year.

UNITED PROVINCES. The season was fairly good for *kharif* crops but excessive rain in the western districts and insufficient rain in Oudh and certain portions of the Benares and Jhansi Divisions affected both the sowings and the outturn. The winter rainfall was on the whole above normal in the Agra, Allahabad, Jhansi, Gorakhpur and Lucknow Divisions and normal in the Meerut Division ; in other Divisions it was below the normal. Frost and hail at the end of the *rabi* season caused damage to winter crops with the exception of barley.

PUNJAB. Conditions were on the whole favourable for the sowing of *kharif* crops but were not satisfactory for maturing them except for cotton ; the supplies of water from the canals were generally sufficient. In the low-lying tracts of some districts *juar* (*Andropogon Sorghum*), *bajra* (*Pennisetum typhoideum*), maize, sesamum and sugarcane were damaged by excessive rains and floods. Sugarcane suffered from 'top borer' in parts of Rohtak, Gurgaon and Karnal. Climatic conditions were also favourable for the sowing of *rabi* crops, but the severe frosts which lasted from the first week of January till the first week of February and the unusual amount of precipitation at the end of rainless winter did not allow the crops to make good growth. Wheat did not thresh out well, and hailstorms also caused some local damage.

BURMA. The early rains were ample, but the late rains failed and large areas which were planted with paddy failed to mature.

BIHAR AND ORISSA. The rainfall during the agricultural year 1933-34 was generally satisfactory and favourable to the winter rice crop, which is the major crop of the province. Excessive rain and floods did a certain amount of damage to the *bhadai** crops in Muzaffarpur, Purnea, Darbhanga, Cuttack and Puri. Sowing of *rabi* crops began in normal time and went on under generally favourable conditions. Excessive cold, frost and heavy rainfall in January caused some damage in Patna, Shahabad, Palamau and Purnea districts. Damage was also caused to the *rabi* crops in parts of Champaran and Muzaffarpur by the earthquake. The light showers during January, February and March were generally beneficial to *rabi* crops and the outturn on the whole was fairly satisfactory. The season was exceptionally favourable to the sugarcane crop which made one of the best stands during recent years.

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* Crop grown and harvested in August-September.

The dominant factor in Bihar in the year 1933-34 was the great earthquake of the 15th January 1934 which devastated the country north of the Ganges between the river and Nepal and from Purnea to the United Provinces. The damage done to buildings does not fall within the scope of a review such as this but mention must be made of the destruction of the Agricultural Research Institute at Pusa, the main laboratories of which were completely wrecked. The consequent decision of the Government of India to transfer the Institute to Delhi is dealt with in another chapter. The earthquake, of course, resulted in the temporary breakdown and cessation of traffic of the railway in the area affected. The restoration of railway communication was, however, carried out very rapidly and traffic was moving again in about three weeks. The most serious agricultural problem at the time of the earthquake was the disposal of the sugarcane crop. The majority of the factories in Bihar were so damaged that they had to cease work, and the cessation of movement on the railway prevented the crop being moved until such time as traffic was restored. The dislocation of transport meant that some 550,000 tons of cane had to be disposed of. It was essential that this problem should be solved because sugarcane is the principal cash crop in this very densely populated area, and the misery caused by the earthquake would have been greatly intensified had the *ryot* been unable to dispose of his cane to reasonable advantage. Of this quantity about one-fifth was taken up by the damaged factories after they restarted and about 120,000 tons by the other factories of the earthquake area. A further quantity of about 100,000 tons was transported to factories outside the earthquake area by a specially constituted Cane-marketing Board. In this operation the Cane Board received the fullest support from the Bengal and North-Western Railway Company and also from the Indian Railway Board, which promptly placed additional metre-gauge wagons at the local railway company's disposal. No fewer than nineteen factories co-operated with the Cane-marketing Board in the disposal of this surplus cane. Though this may have involved a financial sacrifice, at least in some cases, it was a wise move, for it did much to restore confidence amongst cane-growers and to insure future cane supplies. The remainder, a matter of 220,000 tons of cane, was converted into *gur* by the usual indigenous method. The importance of the last means of disposal became obvious as soon as the Bihar and Orissa Agricultural Department reviewed the position. In many parts of India, *gur*-making would have increased automatically but North Bihar had become so largely a white-sugar tract that bullock cane-mills and *gur*-boiling pans no longer existed, and *gur*-making had gone out of fashion in many villages. For once progressive methods proved an embarrassment! This difficulty was soon overcome. The Government of India made a special grant which enabled 3,469 cane-mills and 3,272 *gur*-boiling pans to be lent free of charge to cultivators in the stricken area and the staff of the Agricultural Department demonstrated how *gur* was made in olden times. The shock to the cane-grower was thus greatly lessened and it is satisfactory to note that the planting of the new crop was practically normal.

The actual damage done to land by the earthquake was, viewing the area affected as a whole, slight. In certain districts, however, it was very severe, notably in the Sitamarhi district in which the cracking of the earth and the outpouring of sand was very heavy. Special demonstration parties were organised by the local Department of Agriculture and these toured the affected districts demonstrating to cultivators the methods by which land, which had been damaged by sand, could be brought back into cultivation and restored to its efficiency.

CENTRAL PROVINCES. The monsoon of 1933 set in about the normal time and was fairly well distributed but for heavy showers in July and September. There were severe cold waves and frost in January and February. The average rainfall was 59·33 inches in Central Provinces and 41·31 inches in Berar, as compared with sixty-seven years' averages of 48·77 and 34·36 inches respectively.

The excessive rainfall of the early monsoon proved unfavourable to *kharif* crops except rice, while insufficient rain coupled with frost and cold reduced the outturn of *rabi*. Rust and insect pests caused more than the normal amount of damage. The outturn of all crops except rice continued to be below average and there was a fall in the outturn of gram and cotton.

ASSAM. The distribution of rainfall was on the whole somewhat irregular. The autumn and winter rice crops were considerably damaged by drought, insects and local floods, especially in the low-lying areas in almost all the districts. The weather for the cultivation of *rabi* crops was generally favourable but drought and insects caused some damage in the later part of the season. On the whole, there was increased cultivation under sugarcane, jute, tea, rape and mustard, while there was a decrease under rice as compared with the previous year.

NORTH-WEST FRONTIER PROVINCE. The monsoon during the retreating period was defective. The severe windstorm and heavy rains in September 1933 and April 1934 caused some damage to wheat, maize and the fruit crop.

1934-35

The chief feature of the monsoon rainfall in 1934 was the absence of any marked prolonged breaks, rainfall was fairly well distributed. The rainfall during the monsoon period was within ten per cent. of the normal, except in Rajputana, Central India and the Central Provinces where it was excessive, and in Mysore and Madras where it was in defect. During the retreating period of the monsoon, rainfall was above the normal in Assam and Bengal; normal in Burma, Mysore and the Bombay Presidency proper; elsewhere it was defective, particularly in the United Provinces. Taking the year as a whole, the rainfall was generally within twenty per cent. of the normal.

From the agricultural point of view, the season was not so favourable as 1933-34. The total outturn of rice decreased by thirty per cent., whilst Burma, where the previous season was a favourable one, recorded a fall of twelve per cent. The prospects of a very good sugarcane crop were marred by the cold spell and frost in January. The total production of jute during 1934-35 increased by six per cent. as compared with 1933-34; but the yield of cotton decreased by five per cent., the crop being damaged by excessive rain and frost in some of the important growing tracts. Unfavourable seasonal conditions also affected the yield of groundnut, sesamum and castor seed crops. The total estimated yield of wheat during 1934-35 was 9,725,000 tons, which is three per cent. greater than the yield of 1933-34. Among the oil-seed crops, linseed gave an increased production, while there was decreased yield for rape and mustard, sesamum, castor seeds and groundnuts.

MADRAS. The South-West Monsoon was above normal in Ganjam, Vizagapatam and East Godavari; normal in Chingleput and below normal in the other districts especially in Bellary, Anantapur, Salem, Coimbatore, Trichinopoly and the South. The North-East monsoon was above the average only in Vizagapatam (Agency), North Arcot, Salem, Coimbatore and Trichinopoly and below the normal in other districts.

BOMBAY. The rainfall was good except in the North Gujarat and East Karnatak, while the Deccan and Karnatak were free from the usual wheat rust. A frost of severe intensity and prolonged duration visited Gujarat, Khandesh, Nasik and parts of South Deccan about the middle of January 1935 and caused heavy and wide-spread damages to crops.

SIND. The *kharif* season on the whole was somewhat unsatisfactory. A cold wave of great intensity passed over Sind during January 1935, causing extensive damage to *bosi* wheat.

BENGAL. Except in Western Bengal, the season was satisfactory on the whole for winter rice and *rabi* crops and fair for autumn crops.

UNITED PROVINCES. The monsoon arrived to time and in its early stages was promising. The latter part of July and August was extremely wet and this was followed in many areas by a very dry September which was most in evidence in the Western Districts. The sugarcane crop was affected badly by insect pests, particularly in the western United Provinces. Cotton was adversely influenced by the heavy rains of August. On the whole, the rice crop was fair, though late rice was affected by the scantiness of September rain. The *rabi* season opened well but the disastrous frost in January did harm to both rape-seed and gram, almost wiped out *arhar* (*Cajanus indicus*) all over the province and seriously damaged potato, tobacco and sugarcane in certain tracts. Wheat, which in most areas escaped serious damage from frost, was damaged by hot winds in March.

PUNJAB. The monsoon began normally but ceased early and there was little rain after August. Rainfall in September was very deficient, whilst October, November and December were completely dry in most districts. Short canal supplies, coupled with lack of rain, resulted in a reduction in the area sown with wheat by eight per cent. and seven per cent. on the area for the preceding year and the last ten years' average respectively. Much damage was caused to fruit trees and sugarcane by an unusually severe frost in January. Sugarcane was further damaged, particularly in the south-west Punjab, by insect pests. There was a severe attack of black rust of wheat which reduced the outturn.

BURMA. The season was not favourable for the cultivation of the main crops. The monsoon broke late and the early rains were insufficient. The middle-period rains were ample but the late rains came to an end in October and there were hardly any ripening showers. This spoilt what would otherwise have been a good year for rice in Lower Burma. In Upper Burma the season was only fair. The early rains were deficient and, though the middle rains were abundant, the late rains were light.

BIHAR AND ORISSA. The total rainfall was adequate but the distribution was not by any means ideal, with the result that there was shortage of moisture during critical periods and disastrous floods at other time, which caused a great deal of damage in Tirhut, Patna and Cuttack. The sugarcane crop suffered in the hot weather, but the cultivation of the *bhadoi* crops was retarded and the latter were seriously damaged by heavy floods. Light rains fell throughout the province during the cold weather, but in November rain in North Bihar was so heavy that the normal cultivation of the cold weather crops, which form such an important part of the agricultural economy of this area, was very much delayed and in consequence only fair yields were recorded.

CENTRAL PROVINCES. The persistent and excessive rainfall during the monsoon period resulted in the partial failure of the *kharif* crops except rice which actually benefited. Excessive cold in January and rust in the northern and plateau districts in March reduced the average outturns of *rabi* crops. The average rainfall was 59·33 inches in the Central Provinces and 41·31 inches in Berar as compared with the sixty-seven years' averages of 48·77 and 34·36 inches respectively.

ASSAM. The distribution of rainfall was rather irregular throughout the province. Considerable damage was caused to autumn and winter rice crops by floods, droughts and insects in almost all the districts. The jute season from sowing time onwards was exceptionally wet and culminated in heavy floods which damaged the crop considerably in both the valleys. The weather for *rabi* crops also was not favourable. Continuous rain at sowing time and prolonged drought later on, accompanied by insect attacks, caused much damage to the crops.

2. ECONOMIC CONDITIONS.

The year 1933-34 was the fifth year of the great world-wide economic depression. There was little or no improvement in the agricultural position. With a few exceptions, prices of the various agricultural commodities showed little or no increase on balance during the year. An improvement in tea prices was largely due to the export restriction scheme which was introduced during the year. The table below shows the percentage decline in the Calcutta Index numbers for several important agricultural commodities.

Percentage decline in the Index numbers on the basis of September 1929.

Commodity	December 1930	December 1931	December 1932	September 1933	December 1933	March 1934	December 1934	March 1935
Rice . . .	25	40	50	44	40	52	47	43
Wheat . . .	47	36	34	43	46	49	45	47
Tea . . .	11	47	56	19	..	..	16	..
Oil-seeds . .	43	54	55	58	56	55	43	45
Jute (raw) . .	50	36	58	58	58	53	51	48
Cotton . . .	63	34	39	44	53	51	45	51
Sugar . . .	22	10	15	16	24	26	26	24

As compared with September 1929, the heaviest decline in March 1934 was in oil-seeds and raw jute. Among other agricultural products, the next heaviest decline was in rice and raw cotton. Wheat prices were on a higher level during the first seven months of 1933 than during 1932, but they showed a declining tendency from August till March 1934. The price of sugar was on a lower level during 1933 than in 1932 and the decline towards the end of 1933 was fairly marked. In 1933 tea prices showed a great improvement as compared with 1932, and the rise was most noticeable from June 1933, when the price basis for teas sold for export was much higher than those for internal consumption.

The output of some of the major crops in 1934-35 was less than in the preceding season, but there was some improvement in agricultural prices. Oil-seeds and cotton showed a distinct recovery. During the second half of the year, jute prices also advanced. Wheat, however, fetched lower prices than in the preceding year, but prices of rice improved to some extent. Tea prices were disappointing. On the whole, the agricultural situation was distinctly better than in 1933-34, specially during the latter half of the year.

The periodical reports on the working of the OTTAWA TRADE AGREEMENT showed that it had been of positive value to the Indian export trade in the following agricultural commodities :—Tea, cotton, linseed, groundnuts, castorseed, rice, tanned hides and skins, jute manufactures, woollen carpets and rugs, tobacco, oil-cakes and coir manufactures. As imports of non-Empire paddy into the United Kingdom increased to a marked degree during 1934, His Majesty's Government imposed a specific duty ⅔d. per lb. on paddy of non-Empire origin imported into the United Kingdom. Another important change in the United Kingdom import duties was the imposing of the general duty of ten per cent. *ad valorem* on soy-beans of non-Empire origin. As soy-beans (*Glycine hispida*) constitute a most important competitor of groundnuts and the United Kingdom supplies are drawn almost entirely from non-Empire sources, the duty should enhance the value of the preference which Indian and Colonial groundnuts enjoy in the United Kingdom markets.

THE CROP PLANNING CONFERENCE held in Simla on 8th and 9th June 1934 considered questions connected with the possible over-production of some of India's principal crops. The agenda was prepared by a sub-committee of the Council's Advisory Board. The conference was attended by four Hon'ble Members of the Executive Council of the Governor-General, nine officials nominated by the Government of India and eighteen agricultural and revenue officials nominated by local Governments of nine provinces and ten non-officials. The crops considered were rice, wheat and other cereals, cotton, oil-seeds, sugarcane, tobacco, fodder crops, fruits and vegetables.

As regards *rice*, it was considered that production in India (excepting in Burma) had not outstripped consumption and in Burma, where surplus production might be a possibility, it was not, owing to climatic conditions, a practicable proposition to replace the rice crop by other crops equally remunerative. The conference resolved that the present world conditions in the matter of rice production should be borne in mind by provincial Governments contemplating an increase in the present area of rice.

As regards *wheat*, the conference passed the following resolution :—

" The present world conditions in the matter of wheat production and that the Wheat Import Duty Act is an annual measure (not permanent) are two facts which should be borne in mind by provincial Governments which contemplate schemes involving expansion of the wheat area ".

Cotton. The area under cotton in India in 1933-34 was 23·7 million acres and the yield 4·97 million bales (of 400 lbs. each). In the same year there was an import of 236,000 bales and an export of 2·74 million bales. There is in the Indian Central Cotton Committee an organisation which is efficiently looking after the interests of this crop, and questions regarding it were best left to that body. The conference was informed that a special sub-committee of this committee was investigating the question of the scope for an increase in the total area in India under cotton and the selection of varieties to be cultivated. It had already recommended the extension of a medium-staple type of cotton (Verum) in the Central Provinces and Berar which was suitable for export to the United Kingdom and also in demand for internal consumption. It was accordingly proposed that this cotton should be encouraged in all suitable areas in the Central Provinces and Berar. It is already grown on about 150,000 acres. In Sind, the sub-committee had recommended that a special long-staple cotton area of 300,000 acres out of a total ultimate area of 750,000 should be developed and progress was being made in that direction.

The Conference was informed that, in order to improve the marketing of cotton, a proposal to amend the Cotton Ginning and Pressing Factories Act*, to enable the licensing of ginning and pressing factories in such provinces as consider that desirable, was under the consideration of the Government of India.

The Conference recommended that the question of the future area under groundnuts and castorseed, rape, mustard and sesamum should receive the consideration of the Oil-seed Committee of the Imperial Council of Agricultural Research and that there was scope for an increase of two million acres in the area under linseed. It was recorded that progress would depend on the speed with which the improved disease-resistant varieties now available were brought into general cultivation.

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* Legislation has since been introduced in Bombay and the Central Provinces.

The Sugar Committee of the Imperial Council of Agricultural Research was invited to consider the extent to which any further expansion of the sugarcane area should be encouraged.

The Conference recorded that the area under fodder crops and fruits and vegetables had showed increases and that scope for further extension depended on improved marketing of fruit, vegetables and dairy products.

Tobacco. The area under this crop has remained stationary at about 1·3 million acres and estimated yield at 0·6 million tons. Tobacco is not a crop so extensively grown as to affect the general scheme of crops in India. It is, however, one which has great commercial potentialities. For example, six million pounds of the light bright type of tobacco suitable for cigarettes is at present being imported into India. Research might enable the Indian cultivator to capture this market by growing the requisite kind of tobacco. This would mean an extension of 30,000 acres. More important still is the United Kingdom market. The United Kingdom imports about 300 million lbs. of cigarette tobacco per annum. Part at least of this market can be captured by India and the area under the crop further extended. The conclusion reached was that there was ample scope for an extension of area under tobacco, provided that it was of the right type; but that it was unlikely that the extension of area could, within any foreseeable future, be so great as to make any appreciable difference in the relative importance of crops in India. For those who were prepared and were able to develop the light bright type of tobacco, there was economic advantage in an extension of area, and progress was being made in this direction. The Conference noted that question relating to this crop would shortly be considered by a Tobacco Committee of the Imperial Council of Agricultural Research.

3. THE IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH.

During the period 1933-35, the Governing Body of the Council approved of fifty-three new schemes and the total fund allocated to schemes up to the end of 1934-35 was about Rs. eighty-three lakhs. Of the total number of schemes in operation financed by the Council, seventy-four schemes are under local Departments of Agriculture and sixteen schemes are being carried out by University organisations or private bodies. References to individual schemes of work will be found in the chapters that follow. In Appendix XI would be found a complete list of schemes of the Imperial Council of Agricultural Research in operation, to which funds had been allotted up to the end of 1935.

During the period under review the Council undertook an important extension of its activities, *viz.*, the improvement of marketing of agricultural produce in India. The reports of the Royal Commission on Agriculture in India (1928) and the Central Banking Enquiry Committee (1931) drew attention to the loss which occurs through ineffective marketing and stressed the necessity for some central agency to advise and assist in co-ordinating provincial activities, particularly in the case of agricultural produce intended for export and to give assistance to provincial organizations by way of advice and research. In view of the importance of improved agricultural marketing as an aid to the general economic recovery of the country, Provincial Governments were consulted in July 1933 and on receipt of their replies the Government of India placed the matter before the Advisory Board of the Imperial Council of Agricultural Research for an expression of opinion. The Board unanimously recommended action on the following lines :—

(*a*) The first step should be the appointment for a limited period of a highly qualified and experienced Marketing Expert, with practical knowledge of the organisation of agricultural marketing in other countries of the Empire. This officer and the necessary assistants should be on the staff of the Imperial Council of Agricultural Research and should undertake the investigation of marketing problems and formulate schemes for the improvement thereof, make recommendations as regards standard grades for the various commodities and advise local Governments and provincial Departments of Agriculture in regard to agricultural marketing.

(*b*) Attention should be concentrated in the first instance on the principal commodities.

(*c*) That local Governments should be invited to collaborate with the Marketing Expert by appointing provincial marketing officers.

The Government of India accepted the view of the Advisory Board and appointed in April 1934 Mr. A. M. Livingstone, a senior official of the Marketing Branch of the English Ministry of Agriculture, as its Agricultural Marketing Adviser. A review of the work on agricultural marketing in India during the period appears in subsequent pages.

Among the other activities of the Council during these two years, the following may be mentioned :—

The first meeting of the Crops and Soils Wing of the re-constituted Board of Agriculture and Animal Husbandry was held at Delhi between the 25th February and 2nd March 1935.

The Cattle Breeding Committee and the Animal Nutrition Committee each met twice. The latter made concrete suggestions for the establishment of a Central Animal Nutrition Institute for all-India, which were accepted by the Advisory Board at its meeting held in February 1935.

The Sugar Committee met in July 1935 and examined progress reports on ten research schemes financed by the Council and recommended several schemes for further extension and some new schemes for sanction. Funds for these have since been provided by Government.

At the third International Locust Conference held in London in September 1934, Rao Bahadur Y. Ramachandra Rao, Locust Research Entomologist, was as the Indian delegate. A useful interchange of information took place on several important points including the permanent and *quasi*-permanent locust-breeding grounds of the Desert Locust, the direction of migrations, the influence of meteorological conditions, the best methods for field-surveys and the use of aircraft in dealing with large flying swarms.

The third Imperial Mycological Conference was held in London in September 1934. Dr. W. McRae and Dr. H. C. Chaudhuri represented India. A number of scientific and technical matters were discussed. The adoption of a standard form of phytopathological certificate for plant imports for the British Empire was found practicable and marks a distinct step forward.

At the Third International Congress of Soil Science, which met in July-August 1935, Dr. J. N. Mukherji represented the Indian Society of Soil Science which is the Indian national branch of the International Society of Soil Science. He was also leader of the Indian Delegation, which included Professor S. P. Agharkar, Mr. M. Carbery, Mr. D. V. Bal, Dr. A. T. Sen, and Mr. D. N. Wadia.

The Government of India's annual contribution to the International Institute of Agriculture, Rome, is made through the Imperial Council of Agricultural Research, which also arranges for the Indian Delegation at the biennial meetings of the General Assembly of the Institute. At the Twelfth General Assembly Meeting, 1934, India was represented by Sir Bhupendra Nath Mitra, High Commissioner for India, and Sir Alan Green. As in previous years, the High Commissioner represented India on the Permanent Committee of the Institute.

CHAPTER II.

ECONOMIC WORK ON CROPS.*

Economic work on crops is one of the main duties of the Agricultural Departments in India. It has for its object the increasing of the material sources of prosperity of the cultivator and the work of Departments of Agriculture has achieved success in this respect in many directions. The improvement in crop-production may be secured in many ways, notably by breeding better varieties of seed which will give a product of higher quality or a larger return from the acre, by the introduction of better agricultural implements, by the demonstration and dissemination of improved methods of tillage and manuring and finally by the organisation of methods of disposal, in other words, by creating superior facilities for the disposal of agricultural produce. Within the limits of this chapter are briefly described the important lines of improvement and the results attained in the chief crops. The scientific aspects of the work are dealt with more fully in the subsequent chapter.

The ascertained area under improved varieties of crops in British India in 1933-34 was approximately 16·8 million acres and in 1934-35, 18·6 million acres, as compared with 15·4 million acres in 1932-33. In other words, the recorded area under improved crops has increased by twenty per cent. in the course of the last two years. It may be mentioned that the figures of improved crops are necessarily under-estimates, due to the impossibility of ascertaining the full extent of the 'natural spread' of improved varieties. Tables I and II show the position so far as it can be ascertained :—

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Dr. G. S. Cheema, D.Sc.	*Fruits.*
Mr. P. K. Dey, M.Sc. (Lond.), B.Sc. (Cal. & Edin.)	*Potato.*
Mr. K. McLean, B.Sc., I.A.S.	*Jute.*
Dr. J. S. Patel, B.Sc. Agri., M.Sc. (Cornell), Ph.D. (Edin.)	*Oilseeds.*
Mr. P. H. Rama Reddi, M.A., B.Sc., I.A.S.	*Cotton.*
Rao Bahadur G. N. Rangaswami Ayyangar, B.A., I.A.S.	*Millets and other cereals.*
Mr. T. S. Sabnis, M.Sc.	*Fibres other than jute*
Mr. Hansraj Saini, M.Sc., B.Sc. (Edin.) and Rai Sahib Jai Chand Luthra	*Fodder crops and grasses.*
Mr. R. L. Sethi, M.Sc., B.Sc. Agri. (Edin.), I.A.S.	*Rice.*
Mr. R. C. Srivastava, B.Sc.	*Sugarcane.*
Mr. K. I. Thadani, M.Sc. (Texas.), M.Ag. (Bomb.),	*Wheat.*

TABLE I.

Areas under improved crops in India during 1933-35 (in acres) (so far as information is available).

Name of Province or State	Rice		Cotton		Wheat		Jute		Sugarcane		Other crops.		Remarks
	1933-34	1934-35	1933-34	1934-35	1933-34	1934-35	1933-34	1934-35	1933-34	1934-35	1933-34	1934-35	
British India.													
Madras	793,577	928,841	365,473	489,506	..	..	..	..	42,005	57,043	106,896	72,999	
Bombay Presidency Proper.	2,817	15,414	653,342	617,224	36,894	42,151	..	..	5,528	11,070	624,326	519,233	
Sind	20,075	27,787	110,129	204,290	35,565	105,217	..	..	..	..	4,449	14,522	
Bengal	499,258	516,166	..	..	..	..	1,107,444	1,136,602	113,304	170,762	8,971	13,818	
United Provinces	..	..	329,000	357,000	2,260,000	2,450,000	..	..	1,445,000	1,671,000	412,700	479,700	
Punjab	..	..	1,597,600	1,615,700	2,833,500	3,249,300	..	..	187,300	200,600	..	..	
Burma	860,110	1,032,515	7,376	5,699	13,691	16,075	..	..	8,176	13,311	190,084	248,730	
Bihar and Orissa	28,266	35,673	..	..	45,484	54,342	945	1,014	297,351	358,363	17,926	21,243	
Central Provinces	468,157	528,556	429,853	441,498	477,918	572,399	..	..	..	..	317,884	300,784	
Assam	34,342	30,817	..	..	..	..	31,698	682	10,027	7,836	(a) 2,986	(a) 2,421	(a) Potato.
N.-W. F. Province	..	..	..	300	1,523	25,948	..	..	201	45	2,595	7,360	
TOTAL FOR BRITISH INDIA.	2,706,602	3,115,769	3,492,773	3,731,217	5,704,575	6,515,427	1,140,087	1,138,298	2,108,982	2,490,930	1,688,817	1,680,310	
Indian States (so far as information is available).													
Mysore	182,322	182,357	48,393	32,055	..	..	..	..	10,583	20,408	367,400	468,652	
Hyderabad	587	3,332	31,934	19,674	371	822	..	..	6,567	14,359	20,511	41,283	
Baroda	..	100	8,493	28,125	524	14,384	..	..	..	..	120	..	
Travancore	561	710	..	..	..	..	..	..	..	..	..	..	
Cochin	2,940	4,214	2,960	5,737	..	..	..	..	5	13	57	66	
Kashmir	464	..	..	..	343	..	..	..	..	..	1,572	..	
Gwalior	..	..	..	..	..	..	..	..	..	..	45,500	88,000*	* Includes cotton, *juar* wheat, gram, etc.
Bhopal	..	..	..	..	1,203	4,933	..	..	..	..	..	91	
TOTAL FOR INDIAN STATES.	186,814	190,713	91,780	85,591	2,441	20,139	..	..	17,155	34,870	435,250	598,092	

TABLE II.

Area under improved crops in India (so far as information is available).

	British India.			Indian States.			Grand total for British India and Indian States.		
	1932-33	1933-34	1934-35	1932-33	1933-34	1934-35	1932-33	1933-34	1934-35
Cotton	3,190,667	3,492,773	3,731,217	327,640	91,780	55,591	3,518,307	3,584,553	3,816,808
Wheat	5,316,173	5,704,575	6,515,427	6,149	2,441	20,139	5,322,322	5,707,016	6,535,566
Rice	2,090,553	2,706,602	3,115,769	236,193	186,874	190,713	2,326,746	2,893,476	3,306,482
Sugarcane	1,835,082	2,108,982	2,490,930	16,087	17,155	34,870	1,851,169	2,126,137	2,525,800
Jute	1,003,277	1,140,087	1,138,298	..	..	..	1,003,277	1,140,087	1,138,298
Groundnuts	1,005,053	742,618	611,337	84,976	45,711	44,844	1,090,029	788,329	656,181
Millets†	147,405	176,365	190,906	176,617	120	..	324,022	176,485	190,906
Gram†	248,035	254,770	281,190	..	..	..	248,035	254,770	281,190
Potatoes†	9,883	2,986	2,921	2	2	2	9,885	2,988	2,923
Other crops†	524,605	512,078	593,760	212,835	368,901	511,935	737,440	880,979	1,105,695
TOTAL	15,370,733	16,841,836	18,671,755	1,060,399	712,984	858,094	16,431,232	17,554,820	19,559,840

† Not separately reported by some provinces and States.

1. Rice.

The area under rice in India is about thirty-five per cent. of the total cultivated area. The area under rice and its production in recent years are given in the following table:—

TABLE III.

Year	Area in acres	Production in tons
1930-31	82,846,000	32,198,000
1931-32	84,374,000	33,001,000
1932-33	82,882,000	31,114,000
1933-34	83,042,000	30,864,000
1934-35	81,980,000	30,261,000

The condition of the rice crop in the two years under review was fairly good; in 1934-35, however, there was a decrease of two per cent. in the area and of three per cent. in the yield. The total amount of rice exported from British India during recent years is slightly on the decrease. In Burma, which is the chief rice-exporting province, the problem of producing rice varieties akin to the Spanish rices has become imperative, if the export trade to Europe is to be kept up. The amounts of rice exported from India during the last five years are given in Table IV.

TABLE IV.

Rice exported from British India to foreign countries by sea in the last five calendar years.

Year	From Burma	From Bengal, Bihar and Orissa	From Madras, Bombay and Sind	Total
	tons	tons	tons	tons
1930	2,315,000	116,000	168,400	2,599,900
1931	1,929,700	109,000	121,900	2,160,600
1932	1,883,700	152,400	106,800	2,142,900
1933	1,636,200	98,200	109,100	1,843,500
1934	1,184,000	102,200	108,600	1,394,800

Rice research is now being conducted on a larger scale than ever as a result of the activities of the Imperial Council of Agricultural Research. A number of research stations under departments of agriculture in the provinces are financed by the Council and are engaged in attacking the problems of rice improvement. These stations are Bankura, Suri and Chinsura in Bengal; Berhampore in Madras; Hmawbi in Burma; Sabour, Gaya, Kanke and Cuttack in Bihar and Orissa; Nagina in the United Provinces; Raipur in the Central Provinces and Habiganj in Assam. Besides financing these stations, the Imperial Council has aided the Dacca University and the Royal Institute of Science, Bombay, for investigations on the nutrition of the rice plant. For many years before the co-ordinated scheme of rice research financed by the Imperial Council came into being, much important work had been done by some of the existing provincial stations, which are still engaged in this work. The chief of these are Dacca and Barisal in Bengal, Coimbatore, Maruteru, Pattambi, and Aduturai in Madras, and Karjat and Larkhana in Bombay and Sind, respectively. The schemes financed by the Research Council supplement these activities.

The output of experimental work on rice during the last two years has been considerable: a brief summary of the principal features and problems of the various provinces is made.

BENGAL possesses about twenty-five per cent. of the total area under rice in India. The reported area under rice was 21,672,000 acres in 1933-34, and 20,739,700 acres in 1934-35, as against 21,779,000 acres in 1932-33. The yield was 8,680,000 tons in 1933-34 and 8,273,000 tons in 1934-35, the average of preceding five years being 9,190,000 tons. Among the commercial *aus* (autumn) paddies, Dhairal proved to be outstanding, giving yields up to thirty-two maunds per acre. Bhasamanik also maintained high yields and appeared suitable for all conditions. There were 295 seed centres as against 228 in the previous year, and 11,906 maunds (say 438 tons) of seed were supplied to the cultivators.

The scientific work was conducted chiefly at five centres, each dealing with a particular type of paddy. At Dacca the work is confined to rices of east and north Bengal. Barisal deals with the ' Balam ' rice tract. Chinsura is concerned with the rices of central and western Bengal and the work here is done chiefly with the commercial ' Patnai ' paddies. Bankura and Suri experimental farms serve the Birbhum and Bankura districts, the Asansol subdivision of Burdwan and the western portion of Midnapore district. The western part of the east tract is a continuation of the Chota-Nagpur plateau. The paddy lands here are steeply terraced and the soil is a light loam, thus presenting local problems in paddy cultivation. At all these centres the main item of work has been the collection of paddy samples from the various districts and the isolation of pure-lines from them. About 2,000 types were under observation at Dacca, and an equal number at the rest of the stations. Seventy-two winter paddies were especially examined at Dacca and several of the types were established as pure-lines. Work on the classification of these types is in progress. Preliminary tests with *aus* (autumn) and *aman* (winter) rices on different kinds of soils have been carried out. The results are still inconclusive. A uniformity trial has been carried out at Chinsura in order to investigate certain fundamental problems in the application of statistics to field-experiments with rice, as well as to arrive at the most effective and accurate size of plot for field-experimentation with rice. The experiments carried out have shown that border effect is confined only to the outermost rows and that these show remarkably high yields compared to the interior rows. Studies on the correlation of various characters of rice have also been undertaken in order to investigate the yield components of the rice plant.

Manurial experiments are carried on both in the field and in pots. It was found that, under field conditions, the manuring of the transplanted crop caused yield differences, but the manuring of the seed-bed, though it affected the growth of the seedlings, did not affect the final yield in the field. A cultural experiment using different spacings for transplanted seedlings gave no significant yield differences. A complex experiment was laid down to compare the effects of (*a*) different spacings, (*b*) different dates of transplanting, (*c*) different number of seedlings per hole, and (*d*) different varieties. The yield did not vary with spacings of 6 in., 9 in. and

12 in., or with the number of seedlings per hole. On the other hand, delay in transplanting was accompanied by a lowering of the yield unless closer spacing and larger number of seedlings is used for transplanting. When seedlings of different ages were used, the yield was found to increase with the age of seedlings. In the early varieties dibbling gave better yield than transplanting. In the pot experiments on the best time of application for Nicifos and its effect in different concentrations, it was found that the time of application had no effect on yield. The higher concentrations led to greater tillering and to higher yields of grain and straw.

Histological studies on references to the arrangement and distribution of the mechanical tissues were carried out at Dacca, and it is proposed to use these characters in classification. The question of seed-storage is important. Seed treated with 2 per cent. solution of copper sulphate and with 0·001 per cent. solution of corrosive sublimate remained viable for a long time, but these methods were not felt to be practical. Unslaked lime for desiccating stored seeds is being tried.

Hybridisation work was confined to a study of the size and shape of grain, inheritance of colour and of the time of flowering. Colour in the vegetative parts was found to be recessive in one cross and dominant in others. The well-known American variety (Blue Rose) has been crossed with Latisail. Certain crosses have been made to combine quality and yield with stiff straw and earliness (Jhingasail × Bhutmuri).

BIHAR AND ORISSA. This province possesses about sixteen per cent. of the total area under rice in India, thus coming next to Bengal in point of area. The area and yield during the past few years are given in the following Table :—

Area and yield of rice in Bihar and Orissa in recent years.

——	1930-31	1931-32	1932-33	1933-34	1934-35
Area (in acres) . .	13,927,000	14,081,000	13,072,000	13,229,000	13,734,000
Yield (in tons) . .	5,615,000	5,728,000	4,201,000	4,294,000	4,688,000

In 1934-35 the weather conditions were favourable except in Singhbhum. The total production was ninety-nine per cent. of the average of the past ten years.

Scientific work is being carried on at the Central Station at Sabour with the sub-stations at Cuttack (Orissa), Gaya (south Bihar) and Kanke (Chota Nagpur). A general improvement of the rice crop is aimed at by isolation of strains of superior yield and quality at Sabour. The more local problems, *viz.*, the evolution of varieties adapted to particular conditions of soil and moisture, are dealt with at the sub-stations which also test the suitability of the selections made at Sabour. Since the commencement of the research scheme, about 5,000 paddy cultures have been examined at Sabour. In 1934 about 1,800 samples were collected from North Bihar, Orissa and Chhota Nagpur localities. The more promising of these samples have been retained. The work in connection with the strains of South Bihar, having been under investigation before the advent of the scheme, has now yielded results. Two of the selections, 88 and 89, have proved significantly superior to the standard variety Kanke II, showing twenty-two to thirty-five per cent. increase in yield. Other promising selections are undergoing yield tests at Sabour and the sub-stations. The problem of evolving flood-resistant rices is being studied at Cuttack. At Kanke the problem of evolving suitable '*ghora*'* paddies, adapted to the Chhota Nagpur plateau areas, is being tackled. Resistance to saline conditions, both artificial and natural, is being studied, being important to the saline areas of Orissa.

A necessary rounding off of the pure-line work is the classification of the pure-lines isolated. The scheme of classification used is based upon several characters, importance being given especially to maturity, spikelet-colour, awn, grain-colour and size of spikelets.

Some rices from Dacca, Madras, Bombay, Ceylon, Java, United States of America, Italy and Spain are under observation and acclimatisation.

A study of root-systems under different conditions of manure and soil was continued. Applications of ammophos at the rate of 200 pounds per acre produced the greatest root development in the nursery. Dilute solutions of common salt (0·35—0·50 per cent.) were found to act as an energiser to the roots.

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* Autumn or *aus* paddy (*Oryza sativa*).

At Sabour, pot-culture experiments to investigate the manurial and water-requirements of paddy were also carried out. Among the manures the ammonium salts gave better results than others but a combination of ammonium and nitrate nitrogen proved more effective than separate applications of either. The water requirements of different varieties were found to vary considerably. In a general way, the late varieties required a greater amount of water per unit of dry matter formed than the medium or the early varieties. Similarly, the late varieties required a higher minimum moisture content in the soil for successful growth than the medium or the early varieties. Morphological studies showed that the cultures which stood the drought best had smaller numbers of stomata and smaller epidermal cells. Among the cultural tests, that relating to the use of seedlings of different ages for transplanting gave contradictory results in two years. In the first year the two-week old seedlings and in the second year the five or six-week old seedlings gave the best results. The effect of the practice of 'nigar' (dewatering of plots in canal-irrigated tracts for about a fortnight at a certain stage of the crop) was insignificant. *Aman* (winter) paddy was tried as *dalua* (summer paddy), but it did not do well as the crop was much too late to escape the damage caused by the hot weather.

The dormancy and viability of seed of different classes of paddy have been tested. The period of dormancy is shorter in early and medium types as compared to the late types. In order to enable the seed to germinate soon after it was harvested, it was subjected to different treatments, such as sudden chilling, high temperature, and exposure to the vapours of ether, thymol and tobacco. The use of vapours of acetone and chloroform gave about fifty per cent. increase of germination over the control. Viability could be partially revived by immersing the seed for twenty-eight hours in 0·1 per cent. solution of copper sulphate. Seed germination at different temperatures was also tried, germination was more inhibited at lower temperatures in the medium and late paddies than in the earlier ones. The optimum temperature was about 30°C.

Hybridisation studies have been commenced. The effect on flowering duration of varying the periods of light to which the crop is exposed was investigated in order to make two varieties of different durations come into flower simultaneously.

BURMA claims about fifteen per cent. of the area under rice in India. The area sown was 12,919,000 acres in 1933-34 and 12,666,000 acres in 1934-35, as against 12,702,000 in 1932-33. The 1934-35 crop suffered on account of poor late rains and the attack of insects. The average outturn was eighty-three per cent. of the normal, and the surplus available for export was estimated at 4,324,000 tons of unhusked rice (equivalent to 3,200,000 tons of rice and rice products, or 2,883,000 tons of cleaned rice), which is the same as that reported in 1933-34. On account of the poor prices of paddy, the question of substituting other crops for paddy has received some consideration. The finer varieties of rice do not seem to find favour with foreign countries, hence for purposes of export Burma must produce large-bold rices of the Spanish quality. The indigenous rices of such boldness and size are poor in yield. The problem of improving their size and shape has therefore to be solved through hybridisation. The total amount of seed distributed from experimental, major, minor and private seed-farms in 1933-34 was 13,260,751 lbs. and in 1934-35, 17,223,597 lbs.

The experimental work is conducted chiefly at Hmawbi, Myaungmya, Akyab, Mudon and Mandalay. Varieties from Japan, Formosa, China, America, Egypt and Siam were grown and examined and some of them were retained for further observations. In order to find out if any characters are associated with high yield, growth-studies were carried on for the two years under report. Strains of different durations were grown under different conditions of spacing and periodical records of number of tillers, dates of flowering, yield per tiller, etc., were maintained. A part of the data was statistically analysed and a few conclusions were reached.

The breeding work consisted of a study of F_2, F_4, F_6, F_7, F_8 and F_{10} generations. The number of cultures studied in 1934-35 was 195, representing crosses between local strains and between local and exotic strains. The morphological characters were examined in the field and their grain quality and hulling capacities were tested in the laboratory. The outturn of whole rice from most of the hybrid cultures was equal to or exceeded that from the parental strains, and in almost all cases the grain of the hybrid was of superior quality, being hard and translucent with little or no abdominal white. Compared with the parental strains, the quality of the hybrids was superior, and the yield was either intermediate between the parents or as good as that of the heavier parent.

Before going to the consumer, the harvested paddy has to undergo a series of operations, such as threshing, drying, hulling, cleaning, etc. The place of a particular variety in agricultural economy must be judged in relation to these post-harvest operations. A variety in order to become popular must not only be a good yielder ; it must also possess good milling properties. Similarly, in order to obtain the most economic results, a knowledge of the relation between the milling property and drying and storing methods is necessary. The general impression current among the rice-millers, that the milling quality of rice is influenced by the conditions of the locality in which it is grown and that the quality in a strain varies from place to place, was verified by growing and harvesting a strain at different places. It was found that the differences were mainly in the size of grain, colour of fertile glumes and in the hulling percentages. The last may have been due more to the treatment of the crop after ripening and at harvest than to the influence of the locality itself. Moreover, the fluctuations in the characters studied appeared to be as great from year to year at the same place as they were from place to place in the same year. Investigations into the causes of breakage of rice in millings showed that breaking increased with increased period of sun-drying. Also, there was a close relation between sun-cracking and breakage in milling. The former starts even before the crop is harvested and is greater in samples exposed to the sun and dew than in those exposed to the sun alone, and is least where the grain is protected both from the sun and the dew. Delay in harvesting also resulted in increased sun-cracking and consequent breakage in milling. The milling outturn of whole rice can, therefore, be improved if the crop is harvested before it is over-ripe, and the sheaves, when left for drying, are protected from the sun and dew by means of a thin layer of straw or a roof of light bamboo matting.

The MADRAS Presidency contains about thirteen per cent. of the area under rice in India. The acreage under rice in 1933-34 was 11,704,000 acres and in 1934-35 it was 11,056,000 acres, as against 11,534,000 acres in 1932-33. The yields in 1933-34 and in 1934-35, respectively, were 5,314,000 and 4,981,000 tons, which work out to 1,017 and 994 lbs. per acre. The yield in the latter year represents a decrease of about ten per cent. over the average for the previous five years. Besides the strains Co 1 to Co 9 now coming into general cultivation, two more new strains, *viz.*, Co 10 and Co 11 were released for distribution. The total area under improved paddies was estimated at 800,000 acres in 1933-34 and 850,415 acres in 1934-35. The total amount of seed distributed in the Madras Presidency during 1934 was 1,567 tons as against 1,677 tons last year. The well-known strain G E B 24 continued to be popular everywhere. In the VI Circle, A E B 65 is rapidly replacing the local Nellore samba. The growing demand for high yielding strains is being met by maintaining 844 acres of seed-farms.

The research work on the improvement of rice is being conducted at Coimbatore, Maruteru, Pattambi, Aduturai and Berhampur, the last station being financed by the Imperial Council of Agricultural Research, as already stated. While most of the fundamental work is carried on at Coimbatore, the sub-stations, occupying as they do centres of important rice tracts, deal with local problems, testing strains of promise and distributing the seed to the cultivators.

At Coimbatore 1,120 single plant selections from four commercial varieties were examined in 1933-34. Similarly selections from commercial varieties were grown at other stations. The economic possibilities of growing two strains of identical characters in mixture instead of single strains separately were examined. It was indicated that there was less competition between the plants of different strains than between the plants of the same strain. The pure lines collected are being classified on a colour basis. Yield tests with the isolated strains were carried on at different centres. At Coimbatore, strains of Gobi, 'Patna' and Columba rices were tried and at Berhampur about 350 strains obtained from single plant selections belonging to some of the major varieties, such as Bayya hunda, Ratnachudi, Boropanko, etc., have been tested against a standard variety. Several promising strains were indicated. At Palur comparative trials of semi-dry paddy were in progress.

The manurial trials carried out showed that the application of lime had little effect and that the effects of basic silico phosphate were insignificant. Green-manuring given alone and in combination with ammophos showed that the latter practice gave higher yields but that the extra yield could not cover the cost of the manure. Application of different doses of phosphoric acid in combination with nitrogen did not show significant response to the former. However, at the present price of paddy, it is not economical to apply any of these manures unless a twenty per cent. increase of yield is realised. The best time of application of ammonium sulphate appeared to be four to eight weeks after transplanting.

Cultural trials were carried out at the different stations. Transplanting appeared to be a better practice than broadcasting in long-duration types at Pattambi, but not at Berhampore. Regarding the optimum age of seedlings for transplanting, the results showed that irrespective of seed-rate or the manurial condition of the seed-bed there is no difference between the ages of twenty to fifty days, the time of planting being the more important factor. Beyond an age of fifty days the yield decreased at Berhampore. The raising of seedlings in wet or dry nurseries caused no difference in yield at Pattambi. The practice followed by the ryots of sowing the seed-beds thickly and transplanting the crop in bunches was not found to yield better than the practice of sowing the seed-beds thinly and transplanting single seedlings. Hence bunch-planting is less economic. Spacing the seedlings at six inches in transplanting gave optimum results at Coimbatore, Pattambi and Berhampore but at Maruteru greater spacing was indicated. Root-pruning of seedlings before transplanting decreased the yield at Aduturai. Double transplanting gave slightly higher yields at Maruteru.

The economics of rice-growing was studied at Coimbatore, Pattambi and Maruteru. Rice-growing was reported to yield net profits of Rs. 47, Rs. 65 and Rs. 50 per acre respectively, at the three stations in 1934-35. The effects of storing rice in different receptacles, and of different harvesting and post-harvest operations on storing quality, are being examined at Coimbatore. Vernalization of seed at this station produced no variation from the control.

Fundamental studies on interspecific crosses are being pursued at Coimbatore. Dwarfism in rice has been ascribed to a mutation and mutations from X-rayed progeny were examined. Among new mutations observed were two tetraploids both of which are expected to show gigantism.

Three sets of crosses made in order to produce types matching the grain of Spanish rices were examined. Breeding for resistance to *Piricularia* has been undertaken. For this purpose eleven strains of a cross between Korangusamba and GEB 24 were examined. Five hundred progenies of Co 4×Korangusamba were observed and 132 resistant families were selected. It was found that the cell sap of diseased plants was slightly less acidic than that of the healthy plants. Interspecies crosses between *Oryza sativa* and *O. longistaminata* and between *O. sativa* and *O. latifolia* were made. An F_3 of one-hundred plants of the former cross was examined. F_1 of the latter cross was sterile. It has, however, been back-crossed with *O. longistaminata.*

Cytological studies of chromosome numbers of different varieties are in progress.

The area under rice in the UNITED PROVINCES is about eight per cent. of the total rice area in India. In 1933-34 the area was 5,980,000 acres and in 1934-35 it was 6,436,788 acres as against 6,705,000 acres, the average for previous five years. The total yields in 1933-34 and 1934-35 were 1,736,000 and 1,937,000 tons, respectively, as against 1,535,000 tons, the average for the previous five years. The season in 1933-34 was generally favourable except in the Eastern Circle where the monsoon rains were insufficient. Irrigation supplies were cut short early in the season in some of the irrigated tracts. In 1934-35 the season was on the whole favourable for early rice but the late variety was affected in places for want of rains in October and November. The average outturn in the two seasons under report was, respectively, seventy-four and seventy-eight per cent. of the normal. The quantity of seed of improved varieties (*viz.*, T1, T3, T12, T21 and T23) distributed in 1933-34 from the various circles amounted to 22,638 maunds and 12,338 maunds in 1934-35. The improved seed distributed from the Rice Research Station at Nagina, in 1933-34 and 1934-35, amounted to 57,140 and 90,379 lbs., respectively. T21 has given satisfactory yields everywhere, and being a fairly short-duration type, it is becoming increasingly popular. It has a bold-fine grain and mills well.

The research work on rice is being conducted at Nagina in the Bijnor district. The pure lines isolated in the previous years were maintained, while a few more selections were made from varieties obtained from the different provinces in India as well as from China, Italy and America. Some of the exotics are very early in ripening and are suitable material for use as parents for hybridisation. Some of the pure-line types were subjected to regular yield-trials and the poor types rejected.

The field-experiments conducted at Nagina dealt with manurial and cultural problems of paddy culture. The treatment differences in some of the experiments were insignificant. This was perhaps due to the general high level of fertility reached by the experimental plots due to the previous cropping with gram. While nitrogen in the form of Nicifos or ammonium sulphate increased the yield, the effect of superphosphate was negligible, whether the latter was applied alone or in combination with green manure. Manures applied at different times of the life of the crop gave identical results. In 1934, green manuring with sunn-hemp added to the soil from a crop grown elsewhere was hardly better than no manuring, but in the previous year green-manuring done by ploughing in the crop grown *in situ* gave high outturns. Different combinations of nitrogen and phosphoric acid were tried but no interaction between the two fertilising constituents was visible. Nicifos, sulphate of ammonia and castor cake, applied at different depths produced higher yields when applied at 2″, 4″ or 5″ depth than when applied on the surface. The effect of castor cake on early and late varieties was similar.

In the cultural experiments transplanting gave higher outturns than broadcasting. The effect of interploughing the broadcast crop was insignificant. Double-transplanting was found to have increased the yield and earliness of the early type but not of the late type used. Under broadcast condition, seed-rates varying from twenty to thirty-five seers per acre caused no yield differences, indicating thereby that paddy can adapt itself to varied conditions of spacings. Thick or thin sowing of the seed-beds or transplanting seedlings of different ages did not materially affect the yield of the crop. A rotation experiment to test the suitability of different *rabi* crop in relation to economic paddy-culture is in progress.

Physiological studies of a preliminary nature were undertaken with both early and late types and included periodical measurements of plant height, number of tillers, number of leaves, etc.

Perhaps the most urgent and baffling problem that faces rice-growers in these provinces is the saving of the crop (especially the early crop) from the ravages of the rice fly (*Leptocorisa varicornis*, vernacular *gundhi*). This insect sucks the milky juice of the developing rice grains, and in certain years causes grave damages destroying the whole crop in some localities. The insect is most active from the middle of August to the middle of October, and vanishes at the beginning of the cold weather in November. The cultivators cannot, therefore, grow early-ripening varieties, especially a poor-yielding, short and coarse-grained type known as Sathi. This type, by virtue of its protective sheath, escapes damage. The question of combating the *gundhi* menace by a hybrid between Sathi and a good quality rice was taken up at Cawnpore by Hayman in 1904 but without success. In 1929, the Economic Botanist made few crosses between Sathi and a few of the fine-grained types (*viz.*, T1, T3, T7 and T12). The aim of hybridisation was to secure hybrids which combined the resistant sheath character of the Sathi with the good features (yield, fine grain, etc.) of the finer rices. Such hybrids, when secured, could be very profitably grown in the Sarda Canal tract. The work was transferred from Cawnpore to Nagina in 1932, in which year an F_3 generation of over 500 families of the Sathi crosses was raised. Since then persistent efforts to secure desirable hybrid strains have been made. This venture is remarkable in so far as it is one of the few cases in which a problem of serious entomological nature is being tackled by plant-breeding.

Immunity to the attack of *gundhi* has been definitely secured. About 1,100 hybrid selections were examined in 1933-34 and 500 in 1934-35. Most of these had their ears protected within the sheath and no *gundhi* insect was seen performing its damaging activities. A necessary part of the breeding work was the genetical study of the different characteristics, such as earliness, size and shape of the grain, yield, tillering, sterility and shedding. The hybrids were about seven to ten days earlier than the improved early types now under distribution—a marked advance. Their average range of flowering was greater than that of the pure lines due to genetic impurity, selections to secure purity are still being made and over fifty per cent. of the cultures have already been purified. Continuous selection for a few years more will be necessary to fix the strains completely. The different cultures represented a diverse range of grain shapes. The mean ratio of grain-length to grain-width of 207 plants selected for the F_6 generation was 3·42, the range of variation extending from 2·31 to 4·73. The ratio for the parental Sathi type is 2·57. Thus, the hybrids include some fine-grained plants. In yield the cultures showed a marked improvement, due mainly to the elimination of sterility which had been marked in the previous generations and which had greatly lowered the yields in the F_4 generation. Single plant yields of selections from the different Sathi crosses represented increase of 193 to 237 per cent. over the yield of Sathi plants. Of the forty-five cultures harvested for preliminary yield tests, thirty-nine outyielded the Sathi parent. Variations in tillering, sterility, height of plants, length of panicles, etc., were recorded. It is expected that a few strains will shortly be released for preliminary trials on the departmental farms under the different Deputy Directors of Agriculture.

A different set of crosses was examined for isolation of strains of good yield and short duration. The incidental studies in earliness have shown that the inheritance of flowering duration is due to the interaction of three genes. In inheritance the deep orange colour of inner glumes was recessive to the ' straw ' colour.

A further series of crosses was made, both for deriving suitable strains of commercial worth and for investigating the intensity and duration of hybrid vigour.

Much of the value of a rice when in the market depends upon the percentage of whole grains which it contains. This depends in its turn upon the hulling capacity of the paddy itself, as well as, upon the method of hulling used and the treatment given to the paddy during and after the harvest. The comparative efficiency of different methods of hulling was tested, both early and late varieties of different degrees of fineness being employed. The results of these tests, expressed as percentages of unbroken kernels on the paddy hulled, were subjected to statistical examination. The hulling properties of fresh and stored paddy were also compared. There was an indication that storing improved the percentage of unbroken kernels.

Cooking tests with some of the varieties were carried out. Characteristics such as the time for complete cooking, and the colour, length, shape and bursting of the cooked kernels were found to depend upon the presence and absence of bran, which in its turn was determined by the method of hulling and the amount of polish given to the rice. Other points noted in the tests were fragrance, softness, and the extent of swelling of the cooked rice. Parboiling the paddy affected the cooking qualities adversely, although it improved the hulling percentage.

The cytological investigations were concerned with the evolution of a suitable technique for working out the cytology of the rice plant, and a cytological examination and analysis of some of the paddy types. The cytology of a wild paddy was examined. The abnormal plant, one possibly a mutant from one of the pure lines now widely grown in the United Provinces (*viz.*, T1) and the other a haploid plant from one of the crosses running in its F_5 generation, were observed. The haploid plant possessed only twelve chromosomes in its vegetative parts instead of twenty-four, the required diploid number. A cytological examination of sterility is also in progress.

The area under rice in the CENTRAL PROVINCES AND BERAR is 7·6 per cent. of the total rice crop in India. The weather conditions were generally favourable. In 1933-34 the area under rice was 5,637,000 acres and in 1934-35 it was 5,652,000 acres, the total yield in the two years being respectively 1,657,000 and 1,785,000 tons. The area under improved varieties has shown an increase. In 1933-34 it was 468,157 acres as against 400,281 acres in the previous year.

The research work on rice is carried on at Raipur. Special emphasis is being laid upon biochemical problems, as a result of one of the stipulations of the Research Council, which is financing the research scheme.

The isolation of pure lines and preliminary and final yield tests are being carried out. The number of pure lines isolated is 402. Thirty-four preliminary yield tests, comprising 551 of the new types, were carried out. In the varietal tests the new hybride BP116 gave higher yields than others. Fourteen promising strains of Banspatri, Chhatri and Hargundi have been selected for yield trials.

In the manurial experiments the application of ammonium sulphate or sodium nitrate at different times gave similar responses. Application of Nicifos II only, in doses higher than 50 or 100 lbs. per acre, gave yields significantly above the control. No residual effect of this manure was apparent. A cultural experiment was performed in order to test the best time of practising *biasi* cultivation (interploughing of a broadcast crop a few weeks after sowing). The interploughing was done three, four, five, six and eight weeks after sowing. In 1933-34 the differences in the yields were insignificant, but in the following season the crops interploughed three and four weeks after sowing gave the best response. Manuring of the seed-bed did not affect the final yield. In an irrigation experiment ' standing water ' gave as good a yield as ' running water '.

The method of hybridisation has been adopted for eradicating the wild rice (*karga*). The problem of the wild rice is that it cannot be distinguished from most of the commercial varieties in the earlier stages of the crop. In order to distinguish the latter varieties from the wild rice they are being ' coloured ' through the imparting of prominent colour characteristics of a coloured variety ' Nagkesar ' by means of hybridisation. Nine crosses have been made for the purpose. Three other crosses have been made between Gurmatia, Chinoor and Bhondu strains and Luchai in order to combine in one hybrid strain the high yields of the former three with the stiff straw of the last-named.

At Raipur work is in progress on humus content and its relation to total organic matter and clay percentage in the soil, and the reaction of these soil constituents on the yield of paddy. The rices of better quality were found to be more commonly grown in soils deficient in humus. The optimum range of soil conditions for paddy lies between the pH values of 6·0 and 7·0. Soils above this range are too alkaline and below it are too acidic for satisfactory yields. Forty soil samples from different depths were examined for their humus content and their carbon : nitrogen ratio. Such analysis may throw light on the nitrogen-requirements of soil, for a narrow C : N ratio would indicate a surplus of nitrogen. Application of soluble nitrogenous manures on such soils will not be beneficial.

The mechanical analysis of twenty-six samples from three different depths (*viz.*, 0-6-in., 6-12-in. and 12-18-in.) was conducted. Soils with clay percentages of 30-60 at 6-12 in. depth or of 34-35 at 12-18-in. depth gave satisfactory yield. Higher percentages of clay in these sub-soil regions are better fitted for the growth of coarse rices than of fine rices. The texture of the top 0-6 in. soil can vary within very wide limits without affecting the production of fine rices.

Another important series of experiments consists of the utilisation of bone for manuring purposes. Three different methods of solubilising have been followed and their effects on the yield of paddy will be observed. The activity of the micro-flora as measured by the production of CO_2 was examined in relation to the use of different organic and inorganic fertilizers on *dorsa* (sandy loam) and *matasi* (medium clay) soils.

In acreage under paddy ASSAM comes next to Central Provinces and Berar, claiming about 5½ per cent. of the total area under rice in India. The total area for all kinds of rice in 1933-34 was 4,862,000 acres, and in 1934-35 it was 4,858,000 acres, as against 4,871,000 acres in 1932-33. The total yields in 1933-34 and 1934-35 were, respectively, 1,421,000 and 1,481,000 tons, as against the average of 1,527,000 tons for the previous five years. Both the area and the total yield suffered reduction due mainly to seasonal conditions. In 1933-34 the distribution of rainfall was irregular. The autumn and winter rice crops were considerably damaged by drought, insects and local floods in low-lying areas. In 1934-35 the weather was more favourable. Floods, insects and the rainfall in November damaged the crop in some districts. The outturns in the two years were, respectively, seventy-two per cent. and eighty-four per cent. of the normal.

Assam was the last to take advantage of the co-ordinated scheme of rice research in India under the Imperial Council of Agricultural Research. After various delays, a deep-water paddy research farm was opened at Habiganj. The land was acquired in March 1934 and the greater part of the year was spent with the preliminaries of establishment. The already established stations at Karimganj and Titabar continued to do useful work, on *aus**, *sail** and *asra** paddies, while the Habiganj station has concentrated its attention upon the *aman** and *boro** paddies. Pure-line selection is being conducted at the three stations. At Karimganj the variety Dhalabadal has given promising results and at Titabar, Kopansali has proved of superior worth. The hybrid strains s c 54/10 and s c 94/134a are recommended for general trial. At Habiganj the problems in the *aman* and *boro* groups are different. *Aman* grows in the wet season (April-December) and has to encounter floods, hence the problem is that of evolving varieties which can stand complete submergence in water, which can resist the uprooting action of rushing water and which can increase in height along with the rise in the water-level. In *boro* rice, which grows in the dry season (November-May), the problem is to evolve varieties which can face droughts successfully, especially during the latter part of their life-cycle when the water in the natural depressions in which they are grown dries up. *Boro* rice must ripen early in order to escape damage by hail-storms which are frequent during the harvesting season.

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* *Aus*—Early or autumn rice; *sail*—Transplanted winter rice; *asra*—Shallow water winter rice; *aman*—Broadcast deep water winter rice; and *boro*—Spring rice.

Manurial trials with cowdung, ammophos and potassium nitrate showed significant response to these manures. Different doses of cowdung (100, 200 and 300 maunds per acre) gave insignificant results. Heavy doses of ammophos and cowdung increased the straw but decreased the grain. Cultural trials with different spacings and different number of seedlings at transplanting were carried out. Double-transplanting with *sail* gave increased yields but was not found to be paying with hired labour. Broadcasting with *ahu* paddy gave better yields than transplanting. In *sail* the best results were obtained by transplanting in the third week after sowing, delayed transplanting giving less of straw. Experimental terraced rice-cultivation was carried on in the Government garden at Dhubinalla with seven varieties, and at Karimganj a number of cross-bred strains are under examination. In 1933-34 about 3,000 hybrids were observed, of which 417 were fixed hybrids. Crosses between Australian, Spanish, Patnai and Barisal (Balam) rices were made.

One of the problems being tackled is the collection and identification of rice weeds at Karimganj.

Including Sind and the Indian States, BOMBAY contains about four per cent. of the area under rice in India. The total area sown was 3,137,000 acres in 1933-34 and 2,903,000 acres in 1934-35, as against 3,610,000 acres, the average for previous five years. The corresponding yields were 1,415,000, 1,308,000 and 1,581,000 tons. The opening of the Rice Canal in Sind increased the area under irrigated rice. In 1933 *kharif* it was 258,100 acres and in 1933-34 *rabi* it was 25,100 acres. In North Thana 1,570 lbs. of seed of K226 was distributed. It is estimated that seed-growers and landlords distributed 16,240 lbs. of seed of improved varieties. Other seeds distributed were of types 184 and K42.

Rice improvement work is being carried on at Karjat (Kolaba) in Bombay and at Larkhana (Sind). At the former place comparison of strains is being made and selection from '101' appear to be promising. At the latter place three improved strains of Sind rices, Kangni 27, Jajai 77 and Prong 36, have been obtained, and are being extended in the rice tracts of North Sind. Work has also been started at Tando for the Lower Sind area (Karachi and Hyderabad districts) and selection from local varieties, *viz.*, Motya and Ratrya, have been made. Attempts at acclimatisation of varieties from the Phillippines, from the United States of America and from Italy are in progress.

Manurial experiments with rotted organic matter and Nicifos were conducted. In Sind cultural experiments to test the possibilities of early sowing were laid down. The economic significance of early sowing has increased since the opening of the Barrage canals system which makes the water available about six to eight weeks earlier than the normal time. This enables the crop to be transplanted in May and June, which results in higher outturns. The crop can be saved from 'brown spots' by transplanting it early. A seed-rate of forty lbs. gave better yield than the cultivator's rate of eighty pounds. It was found that the high quality rices were less resistant to 'kalar' or alkali conditions.

Rice hybridisation studies are being pursued at Karjat. Crosses between K42, K226 and B52 were studied. A cross Patni 6×K79 was also grown. In Sind four superior strains of hybrid origin were obtained and the seeds distributed.

PUNJAB. The area under rice in this province is relatively small. The total area under rice was 955,535 acres in 1934-35 and the total yield was 448,000 tons. The department supplied 715 maunds of seed to growers in 1932-33 and 2,238 maunds in 1933-34. Bansmati 370, the best Punjab rice, is growing in popularity and is being sold as Dehradun Bansmati. Injury due to the ‘ rice borer ’ increased in the Muzaffargarh and Dera Ghazi Khan districts. The sowing of early rices reduces the damage. Bansmati, Mushkan and Bango rices are finding favour with the farmers in preference to the local varieties.

Experimental work was carried on at the Kala Shah Kaku Rice Farm. Here a large number of promising selections was tested for yield. Five promising varieties, *viz.* 278 Sathra, Jhona 349, Bansmati 370, Mushkan 7 and 41, were given extended trials under zamindari conditions.

HYDERABAD. This state contains about one per cent. of the total area under rice in India. The acreage was 1,307,000 acres in 1933-34 and 1,184,000 acres in 1934-35, as against 856,000 acres, the average for the previous five years. The corresponding total yields were 364,000, 355,000 and 283,000 tons. The paddy strain Himayatsagar No. 504 evolved by the Economic Botanist is becoming popular.

MYSORE possesses about the same area under rice as that possessed by Hyderabad. The acreages in 1933-34 and 1934-35 were, respectively, 774,000 and 680,000 acres, and the corresponding total yields were 235,000 and 178,000 tons. Varietal tests of paddies were continued on the Hebbal Farm and two varieties have been selected as yielding the best results.

BARODA. The area under rice is about 0·3 per cent. of the total area under the crop in India. The area in 1933-34 was 225,000 acres and 1934-35 it was 228,000 acres. The average for the previous five years was 213,000 acres. The corresponding total yields were 65,000, 67,000 and 53,000 tons. The introduction of early kolam 184 and late 226 strains has been appreciated by the paddy growers. The 184 strain yielded 150 to 175 lbs. more per acre than the local kada. The late type yields as well as the local kolam but is superior to it in quality.

2. Wheat.

On an average, wheat occupies some ten per cent. of the total area under cultivation in India. The estimated area and yield of wheat including Indian States during the last three years are noted below :—

—	Area in acres.	Yield in tons.
1932-33	32,976,000	9,445,000
1933-34	35,992,000	9,424,000
1934-35	34,491,600	9,725,000

India's present production of wheat is approximately equal to her requirements and the exports and imports of wheat during the last three years were as follows :—

—	Exports in tons.	Imports in tons.
1932-33	2,000	33,000
1933-34	2,000	18,300
1934-35	11,000	7,400

Imports were limited to the purchases of Indian flour-mills, under the drawback scheme, for the production of flour for export. An import duty of Rs. 2 per cwt. was in operation throughout the period under review.

The total estimated areas under improved wheats in India during the last three years were :—

	Acres.
1932-33	5,316,173
1933-34	5,703,052
1934-35	6,489,484

The figures for 1932-35 do not include the area under improved wheats in the North-west Frontier Province, which was estimated in recent years at 280,000 acres.

It may therefore be taken that there are nearly 6·8 million acres under improved wheats in India or a little over one-sixth of the total area. Of this area, 3·2 millions are in the Punjab, 2·5 millions in the United Provinces and a little over half a million in Central Provinces.

PUSA. The celebrated Pusa wheats—Pusa 4, Pusa 12 and Pusa 52, well known for their superiority in yield and quality to the *deshi* wheats, occupied nearly ten per cent. of the total acreage under wheat in India. In addition, two new wheats have been recently introduced, one of which (Pusa 111) has been pronounced equal in quality to the best Canadian wheat and the other (Pusa 114) has proved successful in the Lloyd Barrage area in Sind on account of its disease-resistance and quality. The breeding work at Pusa has yielded other strains which promise to meet the special requirements of certain areas. Pusa 101, a cross between Muzaffarnagar and Pusa 22, is reported to have possibilities for spreading in Bhopal State, where a rust-resistant wheat is badly required. Pusa 80-5 has come to be appreciated in the south-east Punjab, on account of its freedom from lodging and black rust. Pusa 111 as well as Pusa 80-5 have been a success in the United Provinces. Pusa 4 has been found to be one of the most promising varieties in the Nizam's dominions. Among the late-maturing types, two promising hybrids, Pusa 165 and Pusa 120, obtained by crossing the Australian variety Federation with Pusa 4 and Pusa 52 respectively, were tried against the established Pusa wheats and the best wheats of the United Provinces and the Punjab. The result of tests conducted in 1933-34 by the Economic Botanist, United Provinces, at Raya and Cawnpore was the outstanding success of Pusa 165, which out-yielded both the best local varieties and the established Pusa types. Pusa 120 did not show the same striking success although it did well at a number of places. The yield trials of Pusa 52 *versus* a local wheat obtained from Muzaffarpur were carried out for three years in succession and in all the years Pusa 52 significantly out-yielded the Muzaffarpur local variety. As reported in the previous review, Pusa 52, which is so well-suited to Bihar conditions, is of very little use under irrigated conditions in the Punjab.

The year 1933-34 was a bad one as far as rusts are concerned, but the yields were, as a rule, above the average. The highest yielding varieties at Pusa were Pusa 101 and Pusa 52. During the year 1934-35 strong winds and rain in February brought about rust attack and lodging and only average yields were obtained from wheat fields which promised heavy crop earlier in the season. The highest-yielding varieties were Pusa 52 and Pusa 80-5.

The bushel weights of the wheats grown at Pusa indicate the quality of the grain during the years under report.

Wheat.	WEIGHT PER BUSHEL IN LBS.		
	Average of past 6 years ending		
	1932-33.	1933-34.	1934-35.
Pusa 4	64·23	64·36	64·90
Pusa 12	61·77	59·76	62·60
Pusa 52	64·72	65·67	65·31
Pusa 80-5	..	..	64·50
Pusa 101	..	65·77	65·95
Pusa 111	..	64·58	63·50

The seed supplied from Pusa and Karnal amounted to 55,036 lbs. in 1933-34 and 44,050 lbs. in 1934-35. It consisted mostly of Pusa 52, Pusa 4, Pusa 12 and Pusa 111. In an experiment to determine the effect of some fungicides on the incidence of 'bunt' disease (*Tilletia indica*), it was found that none of the treatments was altogether effective in controlling the disease though the percentage of diseased ear-heads was reduced. The only fully effective method by which both loose smut and bunt can be controlled is by hot-water treatment.

The Botanical and Mycological Sections of the Imperial Institute of Agricultural Research collaborated with Professor K. C. Mehta of the AGRA UNIVERSITY in the scheme of investigations into the rust diseases of wheat and barley which is being carried out under the auspices of the Imperial Council of Agricultural Research. The scheme has been in progress for about five years and as a result of the investigations, the distribution of the three wheat rusts in India has been ascertained and the number of different physiological forms of wheat rust is now sufficiently known to enable breeding work for the production of resistant varieties to be started with a reasonable prospect of success. Evidence is accumulating that the indigenous Himalayan barberry is comparatively immune to black rust and probably plays a minor part in the maintenance of black rust of wheat in India. The work of breeding rust-resistant wheat is being carried out at Simla by the Botanical Section of the Imperial Institute of Agricultural Research with the aid of a grant from the Imperial Council of Agricultural Research.

On the average of the last three years, the British districts of the PUNJAB had twenty-six per cent. of the total area under wheat in India and produced thirty per cent. of the total crop. In 1933-34 the area under wheat was 9,773,000 acres, showing an increase of about fourteen per cent. over the previous year. In 1934-35, the acreage dropped to 9,038,000. The yields during the two years were 2,794,000 and 3,043,000 tons respectively. Nearly half the area was irrigated, and the remaining half unirrigated. The season was, however, unfavourable and the outturns were not as high as were anticipated. The prices showed a downward tendency and the average price for the province as a whole during the year was Rs. 2 per maund. About one-third to one-half of the total area was under improved wheat. At a modest estimate, the yield from improved wheat was said to be about two maunds per acre better than the indigenous seed. In 1934-35 the area under improved wheat was 3,249,300 acres. The growing period was one of the wettest on record and consequently the damage from black rust was very heavy in the case of the late-sown wheat. The yields obtained were average except in the case of the late-sown crop. The variety 8A continued in great demand, though thousands of acres were under the cross 518 variety, which by comparative trials was demonstrated to be superior to 8A on good lands giving over forty maunds to the acre. Cross 591 appeared to be gaining in popularity. It has an attractive-looking grain and makes excellent ' chapatis '. In yielding capacity, the cross 591 was at least as good as 8A and in many cases it proved better. It was a better yielder than 9D. The variety 9D, which had achieved great popularity as a *barani* wheat, suffered much from black and brown rusts and experiment showed that the cross 591 variety might prove a better type for use under *barani* conditions and on light and poor soils, where 9D was being used. Experiments with Pusa wheats indicated that they required humid conditions and that under canal-irrigated conditions in the Punjab, Pusa wheats were inferior in yield to the local improved wheats. Eighty-eight thousand one hundred and fifty maunds of seed were sold to cultivators during 1933-34 and about 3,200 maunds of pure-smut-free seed of Punjab 8A, 9D, C518 and 591 were produced and supplied to large growers for further multiplication.

On the average of the last three years, the UNITED PROVINCES had twenty-three per cent. of the total wheat acreage in India and produced twenty-seven per cent. of the total crop. The wheat area in 1933-34 rose to 8,452,609 acres by ten per cent. more than in 1932-33. Frost at flowering time, rust attack and hot winds when the grain was swelling resulted in an outturn of seventy per cent. of the normal. Cawnpore 13, Pusa 4 and 12 and Muzaffarnagar continued to hold their own in most circles. Punjab 8A was expanding in the western areas. Pusa 52, an awned variety with excellent *bhusa*, was rapidly replacing Pusa 4 in popularity, especially among small cultivators in the Eastern circle. No variety has yet been produced which is ideal for Bundelkhand conditions, but trials of Central Provinces and other wheats including a collection from Australia may produce a suitable type. Punjab 518, a variety recently introduced, and Pusa 165, 111 and 112 were all new varieties which gave promise of replacing in part some of the older types.

CENTRAL PROVINCES AND BERAR is the third important wheat-growing province, possessing on the average of the last three years ten per cent. of the area under wheat in India. The area sown was 3,441,000 acres in 1933-34 and 3,629,000 acres in 1934-35. The yield in the two years mentioned was 715,000 and 764,000 tons respectively. The area under improved wheats stood at 477,918 acres in 1933-34 and 572,399 acres in 1934-35.

As reported in the previous review, the Sherbati wheats A113 and A115 suffered in popularity owing to unsatisfactory yields obtained in years of drought and under the trying conditions of the year 1933. They appeared to have lost their rust-resistant property. The work of reselection and maintenance of pure stocks has been taken in hand. The main lines of work on the improvement of the wheat crop were the production of rust-resistant and high-yielding types for the main wheat-growing part of the province, and early maturing, hard and awned strains for the south. Several new strains were produced. Five strains for the north of the Province from crosses between A115 and Australian and Palestine wheats were grown during the year 1934-35 and three of them, in addition to their being superior yielders, showed greater rust-resistance than A115.

For the Plateau districts an awned wheat possessing earliness, rust-resistance and high yield was likely to be found among certain crosses between A O-90×P 4 and A O-13×P 4. Work on Haura selections for the south of the Province was being continued and three strains were retained for further testing. The Department organised 6,046 seed farms for wheat in 1933-34 and 6,023 in 1934-35. The total amount of seed distributed was 211,729 maunds in 1933-34 and 196,286 maunds in 1934-35.

In the BOMBAY Presidency including Sind, wheat was sown on 3,147,000 acres in 1933-34 and on 2,808,000 in 1934-35. The outturns were 685,000 and 562,000 tons respectively. Estimates of the total area under improved varieties for the Bombay Presidency proper are 36,894 and 42,151 acres respectively during 1933-34 and 1934-35. The Nasik-Khandesh area is the most important wheat-growing tract in the Presidency. Four Bansi strains Nos. 103, 162, 168 and 224 and two hybrids (Bansi and Khapli), known as Bansipalli strains Nos. 808 and 809, were tested at Niphad with Pusa 4 and the Niphad local according to the Latin Square method. The Bansi strains 103 and 162 were found to be significantly superior to others, while strains 808 and 809 were significantly inferior. The strain 808, being the earliest-maturing strain, was badly affected by excessive cold waves which appeared at the time of grain formation. District trials were conducted in four centres in Nasik district and the improved strains Nos. 168, 808 and 809 gave higher yields than local wheat. Similar trials were conducted in East Khandesh, where Bansi 224 yielded higher than the local and spread to the extent of 500 acres. The Bansi strain 168 was found suitable in West Khandesh. The strain 224 is spreading in the Bhal tract of Gujarat. This strain, which was later by a week to ten days than the local, was found to be more suited to the Eastern Tapti valley up to Amalner. Village trials carried out with this wheat confirmed the previous year's results, *viz.*, that it was superior in yield to the local wheat and the grain fetched from Rs. 2 to Rs. 3 more per ' map ' of 760 lbs. on account of its better lustre. In the western Tapti valley strain 162 was being distributed in previous years and spread to 10,000 acres. Village trials of strains 162, 168 and local showed that both 162 and 168 were superior in yield to the local wheat ; of the two, strain 168 yielded the better. The future policy in the western Tapti valley will be to discourage wheat 162 and give out 168.

In the Nasik district strain 808 is being extended on account of its early-maturing habit and the practice of green-manuring of wheat fields is being greatly extended in west Khandesh.

As a result of the assured water-supply under the Lloyd Barrage canal system, both the area and outturn of wheat in SIND have more than doubled as compared to the pre-Barrage period. The area under wheat was 1,221,000 acres in 1933-34 and 1,074,000 acres in 1934-35. The outturn in 1933-34 was 357,000 tons and in 1934-35, 254,000 tons. Botanical work on the improvement of wheat crop in Sind was concentrated at Sakrand for irrigated wheats and at Shikarpur for unirrigated wheats. The policy of the Agricultural Department has been : (*a*) to replace the present mixed crops by superior high-yielding selections from the local wheats, *e.g.*, Thori, Phandanee, Boojri, etc., and (*b*) to introduce and extend the cultivation of superior quality, ' strong ' and disease-resistant varieties, *e.g.*, Pusa wheat in the Barrage areas. The final selected varieties obtained by the Botanical Section of the Agricultural Research Station, Sakrand, are C Ph 47 (selected Phandanee), A T 38 (Selected Thoree) from North Sind and H S W III (selected Boojri) from lower and East Sind. All these improved Sind wheats gave at least twenty per cent. greater outturn than the ordinary Sind wheat crops from which they had been evolved. These improved wheats were not so much affected by ' rust ' diseases as the local Sind wheats, but at the same time, they were not so highly resistant as Pusa 114 wheat, in an year of bad ' rust ' attack. Experimental work carried out in previous years had indicated that, as a general rule, the selected strains of Sind wheats, *viz.*, C Ph 47, A T 38 and H S W III were higher yielders than any of the imported variety, although some acclimatised wheats mentioned hereunder approached them very closely in this respect. The improved varieties of Sind wheats were ' weak ' wheats and their superiority was almost confined to higher outturn. Among the Pusa varieties tested at Sakrand, Pusa 114 was found to be the most suitable for cultivation under Sind conditions and is being extended in the districts on account of its proved resistance to ' rust ' disease which caused much damage to local variety in the Barrage areas. Pusa 114 variety is a high quality wheat of very good milling properties. Other successful importations include Punjab 8A and Punjab C518 from the Punjab. The latter appeared to be higher yielder and might ultimately replace Punjab 8A variety in the districts. A Sakrand selection of Bina wheat from North-west Frontier Province, known as Bina 139, gave promising results. This improved strain has a long growing period and requires to be sown about a month earlier, *i.e.*, in October, and hence it may be valuable for extension in the Barrage canal areas of North and Middle Sind where the irrigation water available at this time is not being utilised by the cultivators owing to the ordinary sowing season for the wheat crop being later, *i.e.* in November. Other types of improved wheats, if sown in October, are liable to frost damage in the flowering stage. Four varieties of Australian wheats were tested on a field scale and in replicated field trials and yielded well. Three varieties, *viz.*, Early Baird, Khadif and Yetna, were the most promising Australian wheats and will be tested in the districts. The hybrids, C Ph 47 × Pusa 12, A T 38 × Pusa 12, and Manitoba × C Ph 47, appear to be promising. A series of major wheat varietal trials carried out every year at various centres has established that for irrigated conditions the Phandani selection, C Ph 47, was best suited for North and Middle Sind, Punjab 8A for

East Sind and Pusa 114 for general cultivation all over Sind. During 1933-34, there was much ' rust ' attack in Lower Sind, the resistant Pusa 114 variety gave higher yields per acre than the better known Punjab 8A variety, which in normal years is decidedly a better yielder. For *bosi* (unirrigated) conditions in North Sind the improved Thoree wheat A T 38 stood first in point of yield with C Ph 47 a close second. A new, improved selection H S W III appeared suitable for Lower Sind, particularly Karachi district.

The improved varieties are being multiplied on a large scale. The Departmental organisation for the systematic multiplication of the seed of improved varieties of wheat reached the fourth stage during 1934-35. The basis of the organisation was a ' unit ' of 50,000 acres to be finally established under a single improved variety in the last of the fifth stage. Eleven units were being aimed at in the multiplication of improved variety, *i.e.*, 4 for C Ph 47, 3 for A T 38, 2 for Punjab 8A and 2 for Pusa 114. In accordance with this scheme, the amount of pure seed made available for further multiplication was about 4,000 maunds in 1933-34 and 10,000 maunds in 1934-35. Repeated experiments at Sakrand had shown that early November could be utilised economically and profitably for soaking and preparation of wheat land for subsequent wheat sowing in late November or in December. If this method were adopted in general practice, it would enable the wheat-growers to get larger areas of wheat sown than by the present method of delaying the soaking of the land until a few days before actual sowing operations take place. The results of two years' experimental work indicated that a larger outturn could be obtained from wheat drilled 15″ apart in rows than from 9″ spaced plots. In a fertilizer experiment conducted during the last three years by the Chemical Section of the Agricultural Research Station, Sakrand, in collaboration with the Imperial Chemical Industries, Ltd., it was found that the application of 7½ cartloads of compost to a wheat crop, variety Pusa 12, resulted in a slight increase in yield of grain over the unmanured plot by about 5·5 per cent. which was not statistically significant. But the applications of 50, 100 and 150 lbs. of sulphate of ammonia in addition to 7½ cartloads of compost gave highly significant results and the increases in yield on an average of three years amounted to 49, 89 and 120 per cent. respectively over the unmanured plot, which yielded at the rate of 532 lbs. grain per acre.

The area under wheat in BIHAR and ORISSA was 1,222,000 acres in 1933-34 as against 1,235,000 acres in 1932-33 and 1,197,000 acres in 1934-35. The outturn in 1933-34 was 476,000 tons and in 1934-35, 505,000 tons as against 492,000 tons in 1932-33. The area under improved varieties was 45,484 acres in 1933-34 and 54,342 acres in 1934-35 as against 37,907 in 1932-33. Pusa 52 has remained popular all over the Province for some years. It established its reputation as an all-round good variety and covered extensive areas in the 'diarah' lands in Patna and Shahabad districts and other parts of the South Bihar Range. In the varietal tests conducted at Sepaya during 1933-34 it came out significantly better than Pusa 101, 111, 114 and 115 and it gave higher yield than other varieties in the main series at Sabour. But its present position is not quite so certain as it was. The awnless Pusa 165 is quite so good a yielder under the conditions of North Bihar, while in Patna Pusa 113 proved definitely better. In Sabour Pusa 52 was still the best late variety, but it has not been tested against these later selections. Pusa 4 gave higher yield than other varieties in the early series. At Patna the manurial trials indicated that although increased yields were obtained with an application of either sixty lbs. nitrogen or thirty lbs. P_2O_5 per acre, this increase was incommensurate with the extra cost. The most economical application appeared to be 20 lbs. nitrogen under irrigated conditions. Under North Bihar conditions a combination of 20 lbs. nitrogen per acre and 25 lbs. P_2O_5 was the best dose for wheat.

NORTH-WEST FRONTIER PROVINCE. The area sown was 1,041,000 acres in 1933-34 and 998,000 acres in 1934-35 as against 1,013,000 in 1932-33. The gross outturn was 249,000 tons in 1933-34 and 239,000 tons in 1934-35 as against 237,000 in 1932-33. The area under improved wheats was 1,523 acres in 1933-34 and 25,943 acres in 1934-35. The most important variety grown was Pusa 4 which does well on double-cropped irrigated areas and the next in importance was Federation which suited single cropped areas. Several other varieties, *e.g.*, Punjab 8A, Pusa 111, Punjab C 409 and Punjab C 518 were tried during the period under review. At the Tarnab Agricultural Station, Punjab C 409 stood first, Punjab C 518 second and Bina third. At Haripur Farm, however, Federation gave higher outturn than Pusa 4, Bina and Punjab C 409 which gave nearly the same yield and Punjab C 518 and Punjab 8A stood last. On rich irrigated land in Bannu, Bina gave the highest yield, followed closely by Punjab C 518. On soils of ordinary fertility in Dera Ismail Khan, Punjab 8A proved the best. On the sandy soils of Merwat, Punjab 8A again proved better than the rest of the varieties mentioned above. A series of yield trials of wheat in Bannu showed that the average yield of wheat was 503 lbs. grain and 974 lbs. *bhusa* (straw) on *barani* land and 1,209 lbs. grain and 1,806 lbs. *bhusa* on irrigated areas. An application of 48 maunds of farmyard manure per acre to the wheat crop showed a remarkable increase in yield in the case of Punjab C 518, giving on an average a profit of Rs. 14-4-0 per acre and showing great response to the manure applied. A manurial experiment on Haripur Farm showed that the application of sulphate of ammonia combined with super phosphate in equal proportion (1 cwt. each) on Pusa 4 wheat resulted in increased yield of 358 lbs. of grain per acre.

3. Cotton.

As a cotton-producing country of the world, India ranks second in importance only to the United States of America. In the British Empire she holds a unique position. In many provinces and states, cotton occupies by far the most important place among the money crops.

The period under review witnessed a slight increase in the area of cotton in India from the low level of 22,483,000 acres which was reached in the previous year. Despite unfavourable weather conditions at sowing time, the area rose to 24,136,000 acres in 1933-34 and 23,830,000 acres in the succeeding year. The conditions of the growing crop were on the whole reported to be fair in the first year but, in the second year, unfavourable weather conditions, especially the cold spell and frost of January 1935, reduced the yield of the crop, so much so that the average yield per acre in that year was only eighty-one lb. of lint cotton, as compared with eighty-four lb. in the previous year. The estimated total yield of cotton was 5,068,000 bales and 4,807,000 bales of 400 lb. respectively in 1933-34 and 1934-35. The total crop accounted for by press returns and loose cotton received at mills was, however, almost the same during the two years being 5,554,000 bales in 1933-34 and 5,550,000 bales in 1934-35.

Reference was made in the last review to the recession of Indian cotton prices in 1932-33 from the abnormal price relations with Americans which had ruled in 1931-32 as a result of a short crop. The prospects of a normal crop in 1933-34 caused a further widening of the parity between Indian and American cotton prices. A further set-back to prices was the suspension of purchases of Indian cotton by Japan from June 1933 to January 1934. As a result, Indian prices ruled low throughout the season, not only relatively to Americans but also actually, and much more so in the case of short-staple crops. In the succeeding year the prices for medium staple and better styles of short staple stiffened and rose relatively to Bengals and to Middling American, as a result of the damage done to the crops by the cold spell and frost of January 1935.

In the period under report, exports rose from 1,592,000 bales and 2,863,000 bales of 400 lb. respectively in 1931-32 and 1932-33 to 3,269,000 bales and 3,115,000 bales in 1933-34 and 1934-35 respectively. The world's total consumption of Indian cotton which, according to the figures compiled by the International Federation, was 4,220,000 bales during the year ending 31st July, 1933, rose to 4,772,000 bales in 1934 and 5,599,000 bales in 1935. It is extremely satisfactory to report that the consumption of Indian cotton in Indian mills likewise reached a high level, *viz.*, 2,336,000 bales in 1933-34 and 2,612,000 bales in 1934-35. Compared with the corresponding period a decade ago, this shows an increased consumption of about half-a-million bales per annum, The INDIAN CENTRAL COTTON COMMITTEE made further progress in its work of improvement and development of the growing, marketing and manufacture of cotton in India, for which purpose the Committee, though originally constituted in 1921 purely as an advisory body, was later incorporated under the Indian Cotton Cess Act, 1923, and provided with its own funds derived by the levy of a small cess on cotton exported from India or consumed in a British Indian mill. Since its inception fourteen years ago the Committee has been strenuously working for an all-round improvement in the raw-cotton industry of India. Many and varied have been its activities and the most important are dealt at length in the following paragraphs with particular reference to the progress registered in the various legislative and other measures advocated by the Committee for the improvement of Indian cotton. The Committee has established cordial relations with the newly-formed Lancashire Indian Cotton Committee, whose commendable and effective efforts to increase the consumption of Indian cotton in the United Kingdom mean a great deal to the Indian cotton-grower. The publicity and propaganda work of the Committee was also continued during the period under review.

Prevention of the transport of cotton for illegitimate purposes. Cotton, in common with many other agricultural products, is largely bought and sold in India on the reputation for quality of its place of growth. The difference in the quality of cotton that exist between the same or different types of cotton grown in different tracts have therefore always been a source of great temptation to unscrupulous people. Prior to 1923 the import of inferior cotton into areas growing superior cotton, for the purposes of being passed off as the local genuine cotton, mixed or unmixed, was so rampant in certain staple cotton tracts of India, that they lost their reputation for quality, and no premium was thereafter forthcoming for the genuine superior cottons of the tracts, to the great detriment of the growers of those tracts. Under the Indian Cotton Transport Act of 1923, it has since been possible to prevent the import, into selected areas growing superior cotton, of inferior cotton from outside those areas. During the period under review, there were seven such protected areas in the Bombay Presidency, two in the Madras presidency and one in the Central Provinces and Berar. Similar restrictions have also been put into force by the Indian States of Baroda, Rajpipla, Chhota Udepur, Sangli, Hyderabad and Indore to protect tracts growing superior cotton within their territories and lying isolated or interlaced with the British Indian protected zones.

The restrictions referred to above on the whole worked satisfactorily during the period under review. The Government of Bombay in September 1933, amended the notification of May 1931 constituting the Nerbudda-Mahi Protected Zone, as to allow free transport of cotton within the zone from railway stations situated in State territories to stations in British territories. This should be a great convenience to the trade. As the river Mahi affords a natural northern boundary to this zone, the question of refixing its northern boundary, a part of which is now co-terminous with the northern boundary of the Rewa Kantha States which extend beyond this river, is now under the consideration of the Government of Bombay. Another matter which has been brought to light is the exclusion of certain stations on the Tapti Valley Railway both from the Baroda and Bombay notifications, although the area concerned lies in the Surat protected zone. In the Southern Division of the Bombay Presidency where there are three protected zones, check stations were, as usual, established on the borders to prevent illicit import of cotton by road. Some leakage, however, was suspected through the *kutcha** roads, which were not watched.

In the two areas notified under the Act in the Madras Presidency, there is no restriction on the import of cotton of any kind by road and river, and of seed by rail. This limited application of the Act has partially defeated the object. Inferior cotton from the Hyderabad State still continues to come into the Northerns and Westerns zone by road; Malabar and Mysore cottons likewise find their way to Tirupur in the Southerns zone. Steps are, however, being taken to replace the local inferior cotton of Malabar by superior types. As anticipated, the exclusion, from the Northerns and Westerns zone, of the talukas of Markapur and Cumbum in the Kurnool District checked to some extent the import of Coconadas cotton into the Nandyal market.. The disadvantage of having a single zone as extensive as the Southerns area growing different qualities of cotton in different parts, were testified by the import into Virudhunagar of Nadam-Bourbon *kapas* from Trichinopoly district for mixing with good Cambodia of Dindigul and Ayalur.

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* Built of earth.

In the Central Provinces, the area protected under the Act was extended in September 1935 to include the districts of Nimar and Hoshangabad (excluding Narsinghpur Sub-Division), consequent upon the discovery that inferior Rajputana cotton was being imported into Khandwa for purposes of mixing.

Creation and Maintenance of Islands of superior cotton. The Cotton Transport Act can, at best, only prevent the deterioration, through infection from outside, of the superior cotton grown in the protected zone. A necessary corollary of the Act is therefore the institution of measures to eradicate the inferior cottons grown in the protected zone itself.

The Madras Cotton Control Act of 1932 is one such measure. This Act provides for the prohibition of the cultivation and mixing of Pulichai cotton (*G. neglectum*) and its sale in such local areas in the Presidency and for such period as may be notified. Though the provisions of the Act were applied to Madura, Ramnad, Tinnevelly and Coimbatore districts from July 1932, the Act was not strictly enforced that season as ryots had already secured their seed. It was, however, vigorously enforced in the next season in the first-named three districts, after due warning had been given to the cultivators. The strict enforcement of the Act in that year resulted in considerable reduction in the area as well as in the proportion of Pulichai in the succeeding year. The Government of Madras have since notified that the Act would continue to be in force for another three years from 12th July 1935.

Confronted with a parallel situation, *viz.*, the persistence of low quality " Goghari " (*G. herbaceum*) in the Surat Tract, the Government of Bombay have recently enacted a similar measure.

The rapid spread, in the Central Provinces, of Garrow-Hill cotton, a very inferior short-staple variety, so harsh as to be good only for mixing with wool, has caused considerable alarm, and the question of enacting a measure similar to those in Madras and Bombay Presidencies has been commended to the consideration of the Local Government.

With the realisation of the long-cherished hopes of vast areas of new land suitable for long-staple cotton cultivation being opened up under the Sukkur Barrage in Sind, there arose the problem of the practical measures to be devised to create and maintain a large area of superior cotton in Sind. The problem has been under consideration for the past two years, and it has finally been decided that a compact block of 300,000 acres should be set apart in the tract lying to the south of the Jodhpur Railway for long staple cotton, but whether anything short of complete prohibition of the growing and handling of short-staple cotton in the block would ensure the high quality of the tract is a moot point. The period under review witnessed, however, the first steps towards the establishment of a large compact block of staple cotton.

Another direction in which the improvement and maintenance of the quality of cotton is effected is by the organisation of pure seed supply. It is the general experience of cotton-growing countries that varieties "run-out" after a few years. The Indian Central Cotton Committee has therefore been financing several schemes in India for the production and distribution of pure seed of improved types of cotton. Thus, pure seed of Cambodia Co. 2 was distributed in Coimbatore and Salem districts to the extent of 33,000 and 44,000 acres, respectively, in 1934-35 and the previous year. In the Southern Division of the Bombay Presidency three schemes were in operation. From these schemes, pure seed of Jayawant and Gadag 1 cottons was distributed round about Hubli, Gadag and Athani. The total area covered by pure seed amounted to 210,000 acres in 1933-34 and 281,000 acres in 1934-35. In the adjoining Raichur Protected Area of Hyderabad State, the very same types were distributed for an area of 17,090 acres in 1933-34 and 6,370 acres in the next year. Further north in the Deccan canals area, which is essentially a short staple tract, advantage has been taken of the irrigation facilities provided by the canals, and Banilla, a better type originally evolved to replace the local *roseum* mixture of Khandesh tract, is being introduced. In Khandesh a large-scale scheme had been in operation for four years, and the total area under pure Banilla was estimated at 125,000 acres in 1934-35. In the Surat area the Bombay and Baroda Agricultural Departments are working in their respective jurisdictions to extend 1027 A L F cotton in the tract lying to the south of the Nerbuda. This cotton, though very suitable for this tract, is unsuitable for the Broach tract lying to the north of this river. A scheme has therefore been formulated for giving thorough trials to the improved Broach type B D 8 which spins 37s counts as against the 16s of the local mixture. In Sind, the main item of work had been the examination of the suitability of different strains for the old and new cotton areas under post-Barrage conditions and the organisation of their seed-supply. It has since been found that 4 F-98 and 289 F 1 (Sind Sudhar) are the most suitable for the Right and Left Banks respectively. The area of these cottons rose to over 190,000 acres in 1934-35. In the Central Provinces, too, a scheme has been under operation for the last five seasons first for the extension of Verum 262 and, of late, for the extension of other improved types such as Late Verum, Verum 434, Verum 438 and Bani. The total area covered by these varieties in 1934-35 was 108,000 acres.

Improvement of Cotton Marketing.—The Indian Cotton Ginning and Pressing Factories Act, 1925, and similar legislation in Indian States under the provisions of which every bale pressed in India must be in a prescribed manner, affords buyers of India cotton some measure of protection against such malpractices as watering, fraudulent packing, etc. By means of the press marks on a bale, the factory in which it was pressed can be ascertained and by calling for a certified copy of the entries relating to this bale in the press register, the original owner of the bale, that is, the party responsible for the malpractice, can be traced. The possibility of detection and consequent loss of reputation and business should ordinarily exercise a considerable restraint on evil-doers, though of course, there will always be those who would not desist from such practices.

During the period under review eleven cases were reported of bales being rejected as " not a fair tender " under the East India Cotton Association bye-laws on account of excessive moisture. Two of these related to bales pressed in the Punjab, six to bales pressed in Berar, and one each in the Central Provinces, Coimbatore and Navasari. Complaints regarding adulterated, oil-stained or false-packed cotton, received from the Central Provinces, Hyderabad State, Holkar State, were brought to the notice of the presses concerned through the proper authorities and duly warned.

During 1935, both the Bombay and Central Provinces, Governments introduced provincial legislation for the licensing of cotton ginning and pressing factories and the more effective prevention of adulteration.

Another direction in which the improvement of the marketing of cotton in India is being effected is by the establishment of open regulated primary markets to safeguard the interests of the cotton-grower. Bombay, Madras, the Central Provinces, Berar, Hyderabad, Indore, Baroda, Dhar and Sangli have all now in force the necessary legislation or rules for the establishment and control of such markets. Several markets have already been established and the question of establishing more is receiving consideration, as demand arises.

In addition, the interests of the cotton-grower have also been adequately safeguarded at the two central markets of Karachi and Bombay by bringing the genuine cotton trade of these places under the respective control of the Karachi Cotton Association since 1933, and of the East India Cotton Association since 1922. It is noteworthy that of the Board of Directors of the latter body twenty-five per cent. are representatives of cotton-growers nominated by the Indian Central Cotton Committee and by the Government of Bombay. The long-projected idea of introducing common standards for the trade at Karachi and Bombay matured during the period under review. A Standards Sub-Committee consisting of two representatives each of the two Associations and one of the Imperial Council of Agricultural Research met and prepared standards for Bengals, Sind, Sind-American and Punjab-American cottons, which are dealt with by both the Associations. In the case of Broach, Dholleras, Mathias and Oomras, which are dealt with only by the East India Cotton Association, the representatives of the Karachi Cotton Association on the Standards Sub-Committee were replaced by cotton-growers' representatives. A copy each of the standards prepared by the Sub-Committee was retained by the Indian Central Cotton Committee for future reference. It is hoped that in course of time these common standards will pave the way for universal standards for Indian cottons.

Protective Measures against Pests and Diseases.—The restrictions imposed by the Government of India on the import of American cotton *kapas* and cotton-seed with a view to preventing the introduction of foreign cotton pests through such imports, continued in force during the period under review.

In the Madras Presidency the Agricultural Pests and Diseases Act, which enforces the removal from the field of all cotton plants between successive crops, thus creating a " close " period, was applied to the stem-weevil and the pink boll-worm in the districts of Coimbatore, Salem, Trichinopoly and Madura. It is generally admitted, both by agriculturists and the trade, that the quality of Cambodia cotton has improved as a result of the continuous enforcement of the Act for some years.

In the Surat and Broach districts of the Bombay Presidency where the major cotton pest is the spotted boll-worm, efforts were made, during the two seasons under review, to create a " close " period by removing cotton plants and stubbles from the fields before the end of May. It was clearly demonstrated that these clean-up measures could give twenty-five to thirty per cent. more yield. These campaigns were financed by the Indian Central Cotton Committee.

Cotton Statistics.—The Committee continued to compile and publish the monthly statements relating to the consumption of Indian cotton in Indian mills, and receipts of loose cotton into mills in British India, and a weekly statement regarding the purchase and import of American cotton.

The Committee has also instituted a series of Statistical Leaflets, the first of which will be published every season in April, in which an attempt is made to classify the estimated crop of the season according to its staple-length. The first and second issues of this leaflet were published in May 1934 and 1935, respectively. After the close of the season, in August, information regarding stocks of raw cotton held in the country at the end of the season, receipts at mills in India of raw cotton, and exports by sea, is collected and published in Leaflets Nos. 2, 3 and 4 respectively. The first and second issues of these leaflets were published in December 1934 and 1935, respectively. Though the information contained in these leaflets is far from complete, it is valuable as the classified varietal details are not available elsewhere. An annual bulletin is also published in which the supply and distribution of the various types of Indian cotton during the season is examined.

Reference was made in the last review to the appointment of a Cotton Forecast Improvement Sub-Committee. This Sub-Committee continued to meet during the period under review, and made many useful recommendations calculated to improve the accuracy of primary cotton forecasts. A grant of Rs. 11,694 was made to the Government of Bombay to meet the cost of a special staff for two years to investigate the sources of error in Bombay forecasts. The investigations proved useful and several sources of error in the compilation of forecasts were brought to light. The enquiries, financed by the Committee, into the village consumption of cotton were completed during the period under review. Though the reports on some of the individual enquiries have been examined and approved by the Committee, the framing of an All-India estimate for village or extra-factory consumption must await the receipt of all reports, and possibly of fresh enquiries on certain aspects of consumption which have not yet been investigated.

Cotton Research.—The cess collected under the Indian Cotton Cess Act of 1923 is largely devoted to the promotion of cotton research in India. Not only are liberal grants made by the Committee to the Departments of Agriculture in the Provinces and Indian States for purposes of undertaking investigations into the botanical, mycological and agronomic problems of their respective areas, but a Technological Research Laboratory is maintained at Bombay for investigating the technological problems of Indian cotton. The Institute of Plant Industry, Indore, receives its main support from cotton cess funds. In addition, a considerable amount of work is carried on by Departments of Agriculture as part of their regular work. All these activities are dealt at length in the following paragraphs.

Technological Laboratory.—The Committee's Technological Laboratory established at Bombay in 1924 continued, during the period under review, to test small samples of cotton sent by Agricultural Officers. These tests furnish reliable data regarding the fibre characteristics and spinning capacities of their samples. Such information is of great value to cotton-breeders, in particular, as they can, at a very early stage in their work, know the worth of their material. The Laboratory also continued to carry out similar tests on standard Indian cottons, and trade samples submitted by the East India Cotton Association and the Ahmedabad and Bombay Mill-owners' Associations ; the results of these tests were, as usual, published in " Technological Circulars ". In addition to these tests, the Laboratory undertakes on payment of certain fees, laid down by the Committee, tests on samples supplied by individual mills and firms in their private capacity.

Since the close of the year a brochure entitled " Cotton Research in India, being an account of the work done at the Indian Central Cotton Committee Technological Laboratory, 1924-35 " by Dr. Nazir Ahmed, M.Sc., Ph.D., F.Inst. P., has been published in which the work of the past eleven years is reviewed.

Of the investigations in progress at the Laboratory, a few of special interest were the investigations into : (1) the effect on the fibre properties and spinning qualities of cottons grown under the same conditions but with different irrigations, (2) the effect of artificial watering on the spinning quality of cotton, (3) the effect of different degrees of compression on the spinning quality of cotton, (4) the effect, on the spinning quality of cotton, of storage of seed-cotton prior to ginning and (5) the combing of good quality Indian cottons. The results of the last two investigations have already been published in Technological Bulletins.

Considerable progress was also made with the study of quantitative relations between the various fibre characters and spinning behaviours.

The Institute of Plant Industry, Indore, completed its eleventh year during the period under review. This Institute is subsidised by the Committee primarily in order that it may act as a central research station for the elucidation of botanical and agronomic problems of cotton of too wide a nature to be attacked by *ad hoc* schemes. The Committee has also a secondary interest in the Institute in its work for the improvement of local varieties and cultivation of cotton in Central India and Rajputana. A botanical survey of cottons grown in India has been completed and a paper on the botanical classification of cotton has been written. An extensive census of the cotton crops of Malwa and Nimar undertaken during the 1933 cotton season brought to light very interesting facts. Contrary to popular impression, there was no evidence of a recent invasion of Malwa by *roseum* cottons. On the other hand, it is probable that the present proportions between Malwi and *roseum* types, *viz.*, 2 to 7 below the Vindhyan range, 6 to 1 above the Ghats and intermediate ratios on the Ghats, are long standing. The census also revealed that in Malwa over sixty per cent. of all cotton plants were American types of the species *G. hirsutum*. Also in the Nimari mixture an Upland of rather different type known as Malan was found to an extent of about twenty per cent. The genetic programme during the period under review included the study of the inheritance of quantitative characters such as lint length and ginning percentage. The study of genetic variance in (1) relatively uniform material such as Malwi 1 and Malwi 9, (2) crosses between three important agricultural types of *G. arboreum* (Malvi, Bani and Roseum) and (3) interspecific crosses, was in progress. As regards the improvement of the quality of Malvi cotton, the Institute has begun to give out for general cultivation the two selections, Malvi 1 and Malvi 9. The former, though not as good as the latter, is better suited to certain soils and regions.

In the BOMBAY Presidency cotton-breeding work was in progress at Jalgaon (Khandesh) and Broach. The former is partly financed by the Indian Central Cotton Committee and the latter wholly. The Khandesh Cotton Breeding Scheme aims at evolving strains of cotton superior to Banilla and local N. R. in every respect and suitable for the Khandesh tract, particularly in wilt-resistance. Already three Verum selections, *viz.*, N V 56-17, N V 56-3 and N V 57-7, have been found to be better yielders. They are also wilt-resistant and much superior to Banilla in fibre qualities, spinning 33s to 37s standard warp counts. One of them, N V 57-7 gave decidedly better yields than Banilla and N. R. and matured earlier, but it is not as wilt-resistant as the other two strains and is slightly inferior in ginning percentage. The Broach Cotton Breeding Scheme is designed to solve a problem in breeding of immediate economic importance. The Broach tract, extending northwards from the river Par up to the southern boundary of Ahmedabad district, is one of the most important cotton tracts in India and was at one time, perhaps, the most important. Through the infiltration of inferior cotton from the north, this tract lost all its superiority so much so that strenuous efforts have had to be made since 1923 to stem the advancing Goghari, and it may now be said that, within a short time, the Surat tract lying to the south of the river Nerbudda will grow only the superior 1027 A L F. For the area lying to the north of this river, which is the Broach tract proper and for which 1027 A L F is unsuitable, a satisfactory type of cotton has still to be found. As the major portion of this tract, the Nerbudda-Mahi zone, is now protected under the Cotton Transport Act, the improvement of the quality of the cotton grown in this area should be comparatively an easy task if only a suitable variety is available. Unfortunately, the whole tract is badly infested with wilt, and the variety which is desired to be eradicated gins as high as 39·1 per cent. The problem therefore is not only one of obtaining high-yielding and longer-stapled types, but also of combining these qualities with wilt-resistance and higher ginning outturn, as good as that of Goghari, if not higher. During the period under review it was decided to concentrate attention on the first-mentioned three qualities, and breeding work is in progress using B D 8, referred to elsewhere, and N S 12 as the basic stock, as both these have proved to be wilt-resistant, and what is required is only an intensification of this quality.

Breeding work on cotton is also carried on at Dharwar and Surat. At Dharwar the cross Jayawant × 15, now in the sixth generation, has yielded types that gin high like strain 15 and possesses at the same time the economic characters of Jayawant. Six of these types appear promising and the lint of these has been sent to the Technological Laboratory for spinning tests. At Surat, in replicated trials, the variety Broach Deshi 8 has given yields 16·25 per cent. more than the standard 1027 A L F and is undergoing further trials.

SIND. Research work on cotton is largely directed in Sind towards finding the best types of cotton suitable for post-Barrage conditions, and working out the most suitable irrigation and cultivation treatments to be given. The further botanical improvement of such staple varieties as Sind-Americans and Egyptians, which have been found suitable for Sind, was the chief item of botanical research. Selection work within Punjab-Americans, Sudan cottons, and Africans A-12 and U-4 and hybridisation experiments were also in progress. A survey of the cottons grown in Thar Parkar district, undertaken with a view to selecting material for further work on the botanical improvement of the crop, did not however yield any material of value. Efforts were also made for the botanical improvement of quality cottons such as Sea-Island, Boss III and Ashmouni, which could be successfully grown in Sind under favourable conditions. In addition, experiments were under way for ascertaining the best cultural treatment for cotton under post-Barrage conditions. Investigations into the economic and technique of the application of irrigation water and investigations into nutritional requirements of the cotton plant and the red-leaf disease were continued in the Physiological Section. It has now been established that the reduction of intervals between watering at the flowering and fruiting time, *viz.*, August-September, results in higher yield. It is gratifying to note that this observation, combined with the results of past work, now enables the drawing up of an irrigation time-table for obtaining the best results out of the Barrage duty of 100. Physiological research in Sind is financed by the Indian Central Cotton Committee.

The botanical research work on cotton in the PUNJAB is now partly financed by the Indian Central Cotton Committee. The notable achievement of the period under review was the completion of the trials with a few early strains of Punjab-American cotton bred by Mr. Trought, which had been found promising in previous years. It was finally decided that 43 F was the best of these and that it should be given out for general cultivation. This strain is a great improvement upon 4 F, which it will replace. Not only is 43 F ready for the first picking by the first week in October at the same time as *deshi* cotton—and one month earlier than 4 F—but its staple length is $1\frac{1}{32}''$; 43 F spins as high as 35 standard warp counts against the 21s from 4 F. Above all, 43 F is jassid-resistant. Trials with other strains as well as selection work were also in progress. It is interesting to note that a cross between Chinese Million Dollar and Mollisoni has staple just under an inch and is extremely promising.

With the funds provided by the Indian Central Cotton Commitee a survey of the cotton-growing districts of the Punjab was also undertaken to collect data on the incidence of a peculiar abnormality in the growth of some cotton plants, which had been increasingly observed on American cotton on the College Estate since 1929. The abnormality took the form of dwarfing, parts or the whole plant being much smaller in size with miniature leaves, bolls, etc. The survey showed that outside the College Estate the disease was of no economic importance.

A five-year scheme, also financed by the Committee, for the investigation of the causes of the periodic partial failure of American cotton in the Punjab commenced work in March 1935.

The investigation of root-rot disease in the Punjab has been under way since 1932 with the aid of a special grant made by the Indian Central Cotton Committee. The causal organisms have been isolated and identified as two species of *Rhizoctonia.* The presence of both these organisms or any one of them in association with certain otherwise harmless subsidiary fungi increases the virulence of the attack, and no variety of cotton at present grown in the Punjab appears to be resistant or immune to the disease. Observations made during the period under review show that the carriers of disease are the live cotton roots in the soil.

The major part of the cost of study of the three principal cotton pests of the Punjab is also met by the Committee. Investigations on the Cotton White Fly since 1930 have now shown that, though a heavy attack by this pest considerably reduces the yield of cotton, the belief once held by some that this pest was responsible for the cotton failures of the past was unfounded. Spraying with rosin compound can effectively control this pest, but it is doubtful whether it is profitable to do so. As for the two boll-worms, the Canal Colonies and the Western Punjab, where the spotted boll-worm predominates, are comparatively free from the pink boll-worm which does most damage in the South-East Punjab. The control of the spotted boll-worm lay in the direction of a complete removal of all stumps and stalks of the cotton plant from the field during the off-season, a measure found eminently efficient in the Surat tract to bring this pest under control. A thorough clean-up of various malvaceous weeds and ratoon cotton is, like-wise, effective in checking the ravages of the Cotton Leaf-Roller.

Cotton research work in the UNITED PROVINCES was directed to an exhaustive survey of the cotton grown in Rohilkhand and Bundelkhand undertaken with the funds provided by the Indian Central Cotton Committee, and the further systematic study at the farm of the material obtained from the survey. Promising types have been selected for further work. During both the seasons under report the demonstrational and experimental control of the Pink Boll-worm was carried out in the districts of Aligarh, Bijnor and Saharanpur over an area of 46,300 acres in the first season, and 45,000 acres in the second. Heat-treated seed was, as in the previous years, supplied for sowing and it is extremely satisfactory to note that, notwithstanding adverse weather conditions, the fact that cleaner *kapas* and larger yields could be obtained by the heat-treatment of seed before sowing was once again proved.

Botanical research on cotton in the CENTRAL PROVINCES continued to receive, during the period under review, substantial grants from the Indian Central Cotton Committee. In addition, a small grant was made to make a preliminary survey of the cotton boll-worms. The chief activity of the period was the testing and multiplication of the new strain V-434. It is a hardy and prolific cotton yielding lint capable of being spun up to 37s highest standard warp counts as compared with the 8s of Roseum and the 20s of Verum 262. Further it has proved to be the best all-round type at present available, having been successfully grown under a wide range of soil and climatic conditions prevailing in the province. It is expected that the area of this cotton will react 20,000 acres in the current season. Late Verum, a strain selected for areas of heavier and late rainfall, and suitable for spinning up to 36s standard warp counts, is expected to extend over 100,000 acres in 1935-36. V-438 again proved its suitability for lighter soils. Work on Bani, E B 31 and 306 was continued. Buri Ak-Special, a selection from Burhampur Upland, was, on first tests, found suitable for 44s highest standard warp counts. The survey of the boll-worm pests showed that the pink boll-worm was not a serious pest in the Central Provinces, though in conjunction with the spotted boll-worms, the damage done to the cotton crop towards the end of the season was severe. The method of carry-over of both the pests is the same as those noted elsewhere in India, where they have been studied.

In the MADRAS Presidency, breeding work was in progress as before, at Coimbatore, Koilpatti, Hagari, Nandyal and Guntur on Cambodia, Karunganni, H 1 (Herbaceum), Indicum and Cocanadas cotton, respectively. Irrigation, rotation and inter-cultivation experiments were also in progress at Coimbatore.

In addition, four schemes financed by the Indian Central Cotton Committee were in operation during the period under review. The first of these and the oldest, *viz.*, the Herbaceum Scheme, was started in 1923 with the object of evolving a type of cotton as good as Karunganni in lint qualities and as hardy as Uppam. A type possessing the desired qualities has now been obtained and is now under further trials. The second scheme financed by the Committee is the Pempheres and Physiological Scheme. The object of the scheme, as restated in February 1935, is the devising of control measures against the stem-borer and the reduction of shedding of flower, buds and bolls in Karunganni caused by untimely rains. Extensive studies undertaken during the period under report have brought to light that the loss caused by stem-weevil is twenty per cent. by way of mortality and thirty per cent. more by reduction of yield. As regards resistant varieties, it has been found that Bourbon was most resistant to the attack, Buri, Gadag and Durango coming next. Studies on those chemical substances in the plant which resist the ill-effects of the borer's attack were also in progress ; the breeding of resistant varieties is also being started. In the third scheme financed by the Indian Central Cotton Committee, *viz.*, the Fodder *Cholam* Scheme, which started in January 1931, the causes of the harmful effects of *cholam* (*Andropogon Sorghum*) on the succeeding cotton crop in the usual rotation of crop of the Tinnevelly district are being investigated. *Cumbu* (*Pennisetum typhoideum*) shows no such harmful effect, but the cultivator prefers *cholam* on account of the fodder it gives. It has now been proved that *cholam* causes a harmful after-effect only if it is allowed to set seed. Soil studies showed that, in *cholam* soils, the amount of exchangeable sodium was greater than after *cumbu ;* this might account for the loss of permeability. The Nadam Cotton Breeding Scheme is another of the schemes financed by the Committee. In accordance with the object of this scheme, work has been in progress to isolate a suitable annual type to replace the perennial Nadam cotton in the Salem and Coimbatore tracts.

BENGAL. Experimental work on cotton was continued on the Dacca Farm with selected Bengal and American types. A grant from the Indian Central Cotton Committee for a study of the Comilla cottons of the tract has recently been made.

BURMA. Experiments in the breeding of improved strains of cotton were continued at the Mahlaing and Allanmyo Agricultural Stations in Burma. A cross, having a staple of $\frac{3}{4}''$ and capable of spinning up to 20s warp counts, was also found to be a good yielder in field trials on the Mahlaing Central Farm. It has therefore been decided to multiply the seed of this and another less promising strain in district trials. As in the two previous years, demonstration work to improve the individual holdings of cultivators was in progress in the Myingyan Circle during the period under review with the help of a grant specifically made for this purpose by the Indian Central Cotton Committee. More and more cultivators are adopting improved methods of cultivation and getting increased yields and larger profits.

Three schemes financed by the Committee were in progress in the HYDERABAD STATE during the period under review. They were the Botanical Research Scheme started in 1929, the Cotton Survey Scheme started in 1931, and the Pink and Spotted Boll-worm Scheme which commenced in 1933. In the Botanical Scheme efforts are being made to find a type of medium-staple cotton suitable for the once famous Gaorani or Bani tract of the State, and at the same time more profitable to the cultivator than the present mixture. Gaorani 4 and 6, two strains selected in the scheme, appear to possess the desired qualities. As they did well in the district trials made during the period under report, it has been decided to distribute their seed in the next season for about 1,000 and 600 acres respectively. The Survey Scheme is a necessary complement of the Botanical Scheme for the collection of suitable material from indigenous cottons for further selection work in the Botanical Scheme. Preliminary investigations carried out in 1931 and 1932 having shown that the damage done by boll-worms was heavy, the Pink and Spotted Boll-worm scheme was started in 1933 with the object of ascertaining the actual damage done by the boll-worms in the Godavary Valley and their mode of carry-over from season to season as well as control measures.

As in the Punjab, root-rot is a serious disease of cotton in BARODA, and an investigation has been financed by the Committee since 1932. The results hitherto obtained show that a species of nematode *Cephalobus* first injures the tender root-lets of the cotton plants, and through these injuries *Rhizoctonia bataticola* enters roots and causes the disease. The same organism is also responsible for the root-rot of several other crops and weeds. Manurial trials and disinfection treatments were found to be of no avail. The breeding of resistant types of cotton is in progress.

MYSORE. Cotton-breeding work in this State is largely directed to the combining of wilt-resistance with heavier yield and superior lint qualities. The cross H 190 gave very encouraging results. Hybridisation work with Americans, Nadam and certain Indian cotton was also in progress.

BIKANER. The scheme financed by the Indian Central Cotton Committee for the purpose of obtaining superior types of cotton suitable for the Gang Canal area was continued at Ganganagar during the two years under review. The results so far obtained show that Cawnpore 520 is best suited to this area, Mollisoni and 289 F taking the second and third places. The last-mentioned cottons however suffered greatly when the number of irrigations is reduced.

Co-operative Cotton Sale Societies. Further progress was made during the period under review both in the number of co-operative cotton sale societies working in the Bombay Presidency, and in the volume of business handled by them. There was a net increase of four in the number of societies, *viz.*, thirty functioning at the close of the period 1933-35 as compared with the previous biennium. From about 3¼ lakh maunds in 1932-33, the quantity of cotton handled by these societies rose to 4·6 lakh maunds in 1933-34 and to seven lakh maunds in 1934-35. In the value of the produce handled, this meant an increase to thirty-seven and fifty-seven lakhs rupees respectively in 1933-34 and 1934-35 from about twenty-seven lakh rupees in 1932-33. As stated in the last review, there are no co-operative societies in the Madras Presidency which exclusively deal in cotton, though as a matter of course the Loan and Sale Societies or Trading Societies situated in cotton-growing areas handle cotton as well, along with other produce of their members. The Tiruppur Co-operative Trading Society is by far the most important of these societies as it acts as a parent society to many smaller village credit societies affiliated to it, by giving short term crop loans to them on condition that the produce is sold through the Tiruppur society. Like the Hubli and Gadag Co-operative Cotton Sale Societies in the Bombay Presidency, which have undertaken the multiplication and distribution of Jayawant and Gadag I cotton seed in their areas, the Tiruppur Society has undertaken the extension of Cambodia (Co 2). Besides this society, five other societies dealt largely in cotton during the period under review. The total volume of cotton business done by these societies amounted to sixteen lakhs of rupees in the two-year period under review as compared with the twelve lakhs of rupees in the preceding two-year period. In the Central Provinces there are no co-operative cotton sale societies of growers. There were, however, two or three Co-operative *Adat* Societies dealing largely in cotton. The total business handled by them during the period under review amounted to less than a lakh of rupees.

There are no societies of growers in the Punjab purely for the sale of cotton, but there are what are known as ' Co-operative Commission Shops ' dealing in all sorts of produce. There were seventeen such shops during the period under review, dealing mainly in cotton, the business done by the shops being twenty and twenty-one lakhs of rupees respectively during 1933-34 and 1934-35. In the Baroda State, ten and thirteen Cotton Sale Societies respectively worked in the years 1933-34 and 1934-35 and sold lint and seed cotton worth six lakhs and two lakhs respectively. Besides, there was one Ginning Society in the State which ginned four thousand and one thousand *bhars* of cotton respectively during 1933-34 and 1934-35. The cotton crop was damaged by frosts during both these years, the heavier damage having been in the second year under review. This accounts for the heavy drop in the business of these societies during this period as compared with the two previous years. In the Mysore State two Cotton Sale Societies and one Credit Society handled cotton worth Rs. 29,000 and Rs. 17,000 respectively in 1933-34 and 1934-35.

4. Sugarcane.

Weather conditions during the year 1933-34 were reported to be good for the sugarcane crop. Prospects of a very good crop, however, were marred by a severe cold spell and frost that occurred during the latter part of January during 1934-35. The area under this crop in the various provinces of India and the Indian States was 3,478,000 acres in 1934-35, as against 3,311,000 acres in 1933-34; while the production of *gur* (raw sugar), was estimated at 5,134,000 tons during 1934-35 compared with 4,896,000 tons in the preceding year.

The remarkable expansion of the sugar industry in India, following on the grant of protection in 1932, is shown by the rate at which new sugar factories have been built. Prior to 1932-33 there were only thirty-one cane factories in operation. The first batch of twenty-seven new factories (including one small experimental factory) was added during 1932-33. Another sixty-five new factories were built for working in 1933-34, making a total of 123 factories in India, an increase of almost 400 per cent. in two years. A further nineteen new factories were built for working in 1934-35, making a total of 142 factories in India. One hundred and thirty of these factories are reported to have worked during the season 1934-35, compared with 112 factories during the season 1933-34. The production of sugar direct from cane in India totalled 580,000 tons during the season 1934-35 as against 453,965 tons during 1933-34. It is gratifying to note that the highest recovery of sugar on cane was 11·10 per cent. during 1934-35 compared with 10·98 per cent. during the preceding season. The average extraction for the whole of India, however, shows a slight decline, the figure being, 8·66 per cent. for 1934-35 as against 8·80 per cent. for 1933-34. The average extraction percentage in factories in Bihar and Orissa, which had dropped to 8·32 in 1933-34 as a result of the earthquake, recovered to 8·79 in 1934-35, which is not far from the average of this province. In the United Provinces the recovery declined from 9·08 per cent. in 1933-34 to 8·56 per cent. in 1934-35 due to the cane crop having been damaged in two western districts. In Southern India especially in Bombay, the majority of factories had recoveries of over 10 per cent.

The year 1934 was unfavourable for the *gur*-refining industry as *gur* prices were higher and sugar prices were lower than in the previous year. Only eight out of fifty cane-sugar factories which are equipped with plant for refining *gur* and eight out of thirteen refineries, making a total of sixteen, worked during 1934 as against twenty-seven in the preceding year. The total production of sugar refined from *gur* in India during the season 1934 amounted to 61,094 tons compared with 80,106 tons during the season 1933, or a decrease of 19,012 tons. Production of sugar refined from *gur* for the year 1935 is estimated at 40,000 tons. Thus the estimated total production of sugar in India by modern factories during 1934-35 amounts to 618,115 tons compared with the actual production of 515,059 tons during 1933-34.

One of the most important events affecting the world sugar market in 1934 was the action of the United States Government regulating, by means of quotas, the amount of sugar produced for consumption in that country. This step has had the effect of curtailing the aggregate production of those areas which cater for the American market, but the consequent reduction in the 1934-35 crop has been discontinued by appreciable increase in beet sugar production in Europe. According to the latest available estimate by Messrs. Willett & Gray, world sugar production in 1934-35 is estimated at 25,730,022 tons compared with 25,506,413 tons during the preceding year, showing an increase of 223,609 tons. Throughout 1934-35 world prices continued low under the shadow of surplus stocks.

The sugar industry in India being sheltered by a protective tariff, the Indian market is less responsive than it would normally be to the conditions prevailing in the world markets. Indian requirements are, however, not yet entirely met from home production and the existence of large stocks in other sugar-producing areas has acted as a brake in internal prices. The imports of sugar into British Indian Ports during 1934-35 (excluding molasses) amounted to nearly 223,000 tons in 1932-33. Taking the figures of imports through the Kathiawar ports into account, imports during 1934-35 were very nearly 334,000 tons, being only about 800 tons less than in the preceding year.

The price of Java white sugar at Calcutta was Rs. 10-4-9 per maund on the 1st April 1933 as compared with Rs. 9-13-0 per maund of Indian sugar on the same date. On the 19th May the price for Java declined to Rs. 10-4-3 rising to Rs. 10-7-3 by the 2nd of June. On the 7th July, it again declined to Rs. 10-6-3, the price of Indian sugar at this time being at Rs. 10-3-6. As the stock was low, prices considerably improved touching Rs. 10-9-6 for Java and Rs. 10-6-0 for Indian sugar in the first two weeks of August. The price thereafter moved downward and after fluctuations touched Rs. 10-7-0 on the 1st December, on which date the price of Indian sugar was about Rs. 10-1-0 per maund. On 29th March 1934 the price stood at Rs. 10-1-0 for Javas and Rs. 9-6-0 for Indian white. On the 6th April the price for Java sugar was maintained at Rs. 10-1-0 per maund compared with Rs. 9-4-0 per maund for Indian sugar on the same date. The price for Java dropped to Rs. 10-0-0 in the succeeding month and by a further 2 annas in June. In August there was a further depreciation to Rs. 9-12-6, but in September an improved consumers' demand was responsible for a rise to Rs. 9-14-0 on the 14th of that month as compared with Rs. 9-10-0 for Indian sugar. By the end of November Javas touched Rs. 9-6-0, while the price of the Indian sugar was Rs. 9-1-0. December saw prices nearly at the same level. In January 1935, there was a revival of demand and stocks were also low. The price of Java sugar reached Rs. 9-9-0 during the last week of January, while the beginning of February saw another advance by one anna. But the rates again dropped in the absence of a strong demand, the market anticipating a further fall in values. During the remaining portion of February and throughout March prices moved within narrow limits and the year

1934-35 closed with the price of Java sugar at Rs. 9-9-0 and of Indian sugar at Rs. 9-1-6.

During the years under review, the IMPERIAL SUGARCANE BREEDING STATION of the Imperial Agricultural Research Institute at COIMBATORE continued the evolving of improved types for all parts of India and also continued its work on cane-breeding technique generally. It was found that the planting of canes at different seasons and under different soil conditions synchronised their times of arrowing to such an extent as to enable crosses to be effected which were not possible hitherto. Canes of Co 290 when subjected to six-hours day light flowered twenty-six days earlier than the controls, but the pollen gave only one per cent. germination when cultured artificially. A modified form of topping, concentrating on the side-shoots, was started with the object of further influencing the time of arrowing. Canes of P O J 2878, when 'topped' twice, flowered eleven days later than the controls; this enabled crosses to be made on a bulk scale with Co 290 and the germination of the seeds was satisfactory. The early ripening cane Co 299 is now available to the cultivator as an improvement over Co 214 in yield and Co 331 as a late cane to fill a position not hitherto occupied by any Coimbatore cane, thus helping to prolong the total period of crushing. A programme of in-breeding was carried on with Co 214 and it is reported to have proved useful in yielding seedlings as immune to mosaic as Co 214 itself and others giving high, early sucrose in juice, another prominent character of Co 214.

Other studies during the years under review included—

(i) Isolation of arrowing canes,
(ii) Effect of arrowing on juice quality,
(iii) Characteristics of certain thick cane seedlings,
(iv) Morphological and cytological studies on canes,
(v) Pollen studies.

Experiments on germination confirmed the previous finding that in a three-budded sett, the central one germinates the quickest and the best. Experiments on germination in thick cane seeds were continued. This consisted of the comparison of Vellai with two of its seedlings, *viz.*, Co 400 and Co 403 for seed germination when the same pollinating parent was employed. The male parents used were E K 28 and Co 205. It was observed that the largest number of germinations were obtained when Co 400 was employed as the ovule parent. The flowering habits and floral characteristics of twenty varieties of *Saccharum* were studied. Observations were also made on the development of root-system of the most important standard varieties and the promising seedlings. Co 419 and Co 421 showed satisfactory root system as compared with Co 213, Co 290 and P O J 2878.

Performance of Coimbatore canes in sub-tropical and tropical India and in foreign countries. Co 223 is reported to be successful in the Kangra district of the Himalayas and at altitudes of over 4,000 feet above sea-level. Some of the new canes are reported to show promise. These are Co 361 in North-West Frontier Province, Co 408 at Karnal (Punjab), Co 413 at Shahjahanpur (United Provinces), Co 361 and Co 407 at Jorhat (Assam), and Co 360 and Co 402 at Padegaon (Bombay Presidency). A marked feature during 1934-35 has been the good performance of two thick canes bred at Coimbatore. Co 419 has proved the most outstanding among these canes for tropical conditions. It has shown better growth than the wonder cane of Java P O J 2878, in certain parts of tropical India. Very good preliminary reports have also been received about the performance of Co 421 from more than one station in Northern India. It is likely to take definite place in the future as a semi-irrigated cane. Co 213, Co 218 and Co 290 continued to be popular over certain areas in tropical India. Co 243 and Co 313 are the new medium canes of promise in the Anakapalle tract of the Madras Presidency, while Co 290 is reported to have found a definite place in parts of the Bombay Presidency under comparatively adverse conditions of soil and irrigation. Co 281 and Co 290, followed by Co 213, are reported to be proving useful in foreign countries like Argentina, Louisiana, South Africa and Australia. The former two would appear to have revealed unsuspected resources of both drought and

PLATE 1

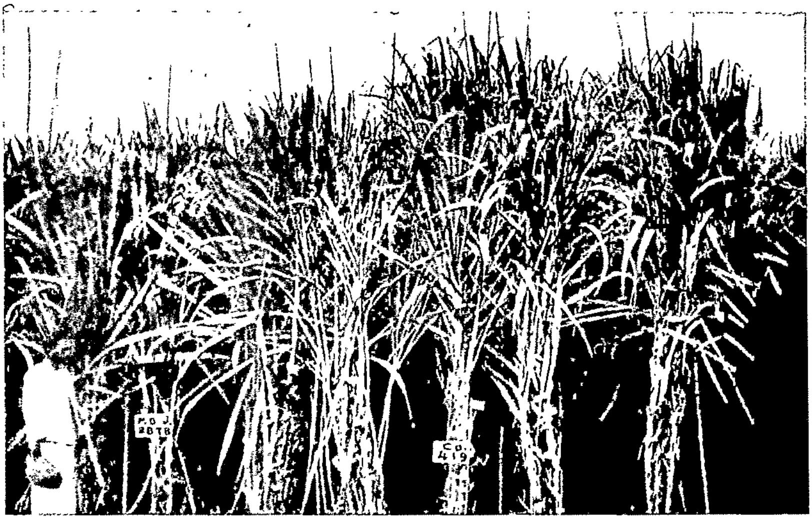

FIG. 1. Growth of Co. 419 as compared with P. O. J. 2878 at the Agricultural Research Statio
Anakapalle, Madras Presidency. (By kind courtesy of the Superintendent, Anakapall
Station.)

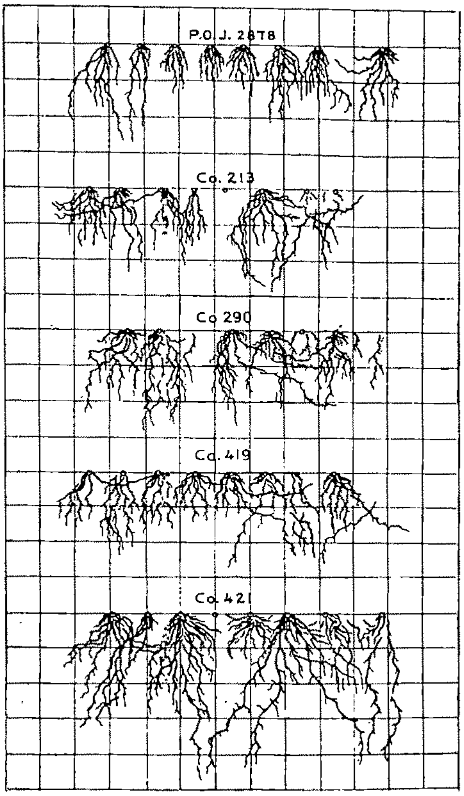

FIG. 2. Root systems of Co. 419 and Co. 421 (12 weeks after planting) as compared with thr
standard canes.

disease-resistance, outrivalling a cane of even such outstanding type as Uba.

Sugarcane-sorghum hybrids. Crosses between sugarcanes and sorghum yielded a certain number of selections some of which were characterised by high sucrose and purity percentages. The combinations with Coimbatore canes gave, on the whole, better types than that with P O J 2725. The F_1 hybrids between P O J 2725 and *Sorghum durra* (Stapf) crosses with the sorghum male parent yielded a rather interesting series. Co 356 is reported to have shown promise in more than one North Indian Station. It is reported that some of these hybrids, though not fit for milling in six or seven months as at Coimbatore, are expected to be the earliest to mature during the ripening period for canes in some of the areas in sub-tropical India. In tropical India the most extensive tests with these hybrids are reported to have been carried out in the Madras Presidency. It was found from preliminary experiments that certain of them attained a purity of 85 and over in about 200 to 220 days from the time of planting and improved in quality for nearly 100 days afterwards. The juices of sorghum hybrids at the point of their maximum efficiency are reported to be richer than those of other Coimbatore canes. These hybrids are of very great scientific interest and will receive further study. Their economic value has still to be determined.

At the SUGARCANE SUB-STATION, KARNAL,* maintained by a grant from the Imperial Council of Agricultural Research, about 6,000 seedlings composed of equal numbers of the crosses Co 213 ×Co 285 and Co 213×Co 244 were grown. These ultimately yielded fifty-five preliminary selections, five of which are superior in juice quality to Co 285—the most popular cane in the Punjab. Observations were made at Karnal on the correlation between the depth of root-system and frost-resistance. Of the eleven varieties whose roots were six feet deep, eighty-two per cent. escaped slight injury and eighteen per cent. were moderately affected. On the other hand, of the thirteen varieties whose roots were only three feet deep, 61·6 per cent. escaped injury and 15·3 per cent. were moderately affected, while 23·1 per cent. were seriously affected by frost. Periodic hand-refractometer readings for estimating juice quality gave useful information not only on the time of maturity of the different types but also the period during which the different canes maintain their juice quality without serious deterioration.

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* Seedlings raised at Karnal from seed set at Coimbatore are designated Cok,

IMPERIAL INSTITUTE OF AGRICULTURAL RESEARCH, PUSA.

The testing and multiplication of new varieties of sugarcane from Coimbatore were continued. After all sorts of trials, setts of the three varieties, *viz.*, Co 331, Co 313 and Co 299 were distributed in large quantities and it is reported that they have proved extremely useful on the growers' estates and there is a regular demand of setts of these varieties. Tonnage yield trials with Co 210, Co 213, Co 313 and Co 331 were carried on with six replications for each. The crop was cut in the middle of the season. The results showed that Co 331 was better than Co 210, Co 213 and Co 313 while Co 210 was better than Co 213 and Co 313. The experiment for tonnage yield with the varieties Co 213 and Co 313, laid out according to Beaven's half-drill-strip arrangement with fourteen replications for each variety, showed that Co 331 was the better of the two. The experiment with Co 210 and Co 213 had been carried out for five years and it was found during 1934-35 that Co 210 excelled Co 213. The tonnage yield for these varieties depends much upon the monsoon variation and local soil conditions. The experiment was conducted on same lines as before with twelve replications for each variety.

Manurial experiments with rape-cake and super-phosphate on Co 213 were laid out with six replications for each treatment. The manures were applied at the time of planting and the amount of phosphoric acid in rape-cake was allowed for in the main dressing superphosphate. The conclusion from these manurial experiments carried out for the last three years shows that application of 40 lb. nitrogen in the form of rape-cake and 50 lb. P_2O_5 as superphosphate is the most economical treatment in the Pusa soils. Manurial and rotation experiments were also conducted. The object of this experiment was to maintain the land in the best possible condition for a close cane rotation such as cane-fallow-cane. The experimental area was under cane during 1931-32. The treatments per acre were: (1) fallow in *kharif* and fourteen tons farmyard manure applied at the end of the Monsoon, (2) fallow in *kharif* and complete minerals (40 lbs. N. as ammonium sulphate, 52 lbs. P_2O_5 as superphosphate and 40 lbs. K_2O as potassium sulphate) applied at the time of planting, (3) Sunn-hemp sown in *kharif* and ploughed in after eight weeks with 50 lbs. P_2O_5 as superphosphate, 50 lbs. N. as rape-cake applied at the time of planting, (4) Sunn-hemp sown in *kharif* and ploughed in after eight weeks, complete minerals (as in treatment No. 2) applied at the time of planting, and (5) fallow in *kharif* and standard manure (40 lbs. N. as rape-cake and 50 lbs. P_2O_5 as superphosphate) applied at the time of planting. The results showed that the treatment No. 1 gave the highest yield followed by treatment Nos. 3 and 2, while treatment Nos. 4 and 5 gave almost similar results as treatment No. 2. Experiments with organic and inorganic fertilizers on Co 210 with six replications for each treatment showed that the dressing of 20 tons farmyard manure was the best. Similar experiment with Co. 213 also showed the same results. The second year's (1934-35) experiment on the effect of silt and farmyard manure was carried out with Co 213 and the results show that silt in bulk is of considerable advantage when ample farmyard manure cannot be obtained.

Spacing experiment with Co 210 and inter-locking experiments with lodging sugarcane varieties were also performed. During 1933-34, experiment on trashing of early-ripening canes for seed with Co 214, Co 299, Co 281 and Co 313 were continued and the damage caused by jackals and pigs to the standing crop was found to be less in comparison with the previous year's loss. In germination study made on trashed and fresh canes under field conditions, it was found that percentage of germination was more in the case of trashed seed in all varieties except Co 299 where fresh seed gave better result.

In the UNITED PROVINCES the area under improved varieties of sugarcane was eighty-six per cent. of the total area under cane during 1934-35, compared with eighty-one per cent. during the preceding year. In varietal trials, Co 313 was the best yielder, closely followed by new selections Co 341 and Co 350. The latter is, however, susceptible to mosaic. In terms of sugar, Co 313 maintained its position, followed by Co 350 but Co 347 and Co 349 are reported to be better than Co 341. Cos 213, 244 and 290 held the field in many areas, though Co 300 and Co 312 are reported to be gaining ground in the eastern Rohilkhand and Western Circles.

Shahjahanpur has for many years been the central station for sugarcane research. With the aid of a grant from the Imperial Council of Agricultural Research, a new sub-station was added at the Muzaffarnagar farm, for research on cane agronomy and cane entomology, to meet the particular needs of the Western Districts. The research undertaken at the above stations included the testing of new types, raising of cane seedlings, carrying out of chemical, physiological and manurial tests on cane. Seedlings raised at Shahjahanpur from seed set at Coimbatore are given the designation CoS. The hybrids CoS 5 and CoS 19 obtained by crossing Co 210 and Co 244 are already being used in field trials. They are found to be hardy, late ripening canes and are likely to replace Co 213 which has deteriorated, largely due to bad farming practice, in certain areas. Of the new arrivals, COK 1, Co 386, Co 421 and Co 428 are among the most promising. Co 285 has been found to be very suitable for dry regions. Under chemical research, investigations have been in progress on the effect of (1) organic and inorganic manures on the maturity of cane and sucrose contents, (2) selective absorption of different materials at the different periods for life of cane. The physiological researches included investigation on (1) studies on interrelation of nitrogen manuring and water duty on the growth of the plants, (2) effect of climatic conditions on the growth of cane plants, (3) studies in the development of sugarcane in relation to various soils with particular reference to root growth. Agronomical trials consisting of manurial, cultural and irrigational were also under progress. In the application of molasses the best result was shown by addition of 270 maunds of molasses per acre two months before planting. In cultural trials trenches at a distance of four feet and in flat sowing lines three feet apart followed by earthing indicated best results. Experiment on the irrigation of sugarcane showed, as in previous years, that the influence of this factor on yield was more closely allied to the frequency with which irrigation was given rather than to the quantity of water given at each irrigation. At the Muzaffarnagar Sub-station, the incidence of various sugarcane pests such as borers, pyrilla, and white fly were studied. The effect of frost on cane was also under examination so as to secure a rough and ready method of assessing frost susceptibility. There appears to be some correlation between the heaviness of transpiration and frost susceptibility. The leaves of cane which are less susceptible to frost were found to yield less water, when cut and stored before sunrise. Co 312 and Co 247 and Co 350 showed less water loss and were less susceptible.

As regards manurial trials it is reported that green manure with sann increased the yield by over forty per cent. and could be profitably augmented by cow-dung or ammonium sulphate, but not by castor-cake. Castor-cake alone at 120 lbs. nitrogen to the acre, gave better results than equivalent mixtures of castor-cake and ammonium sulphate, or farmyard manure and ammonium sulphate, all being better than farmyard manure alone. Where green manuring cannot be done, castor-cake alone is indicated if cheap and readily available or alternatively cow-dung supplemented by a latter dose of ammonium sulphate.

BIHAR AND ORISSA. The indigenous canes are now almost extinct, occasional small patches being met with only in the interior of the province, so that the area under improved Coimbatore canes may be put at about ninety per cent. of the entire area under cane. Co 213 is still the outstanding mid-season variety in the province, although it has a very serious rival in Co 331—a recent Coimbatore production— in the area south of the river where the new variety has universally out-yielded Co 213 and possessed as good a sugar-content. In North Bihar, however, this new variety is definitely late and likely to serve the mills best from about the middle of

February to the end of April. In the field trials conducted at the research station this variety yielded over forty per cent. more than Co 213. Another recent Coimbatore variety Co 299 is supplanting Co 214 in this tract, while Co 313 has been distributed as a medium early variety. This latter variety is also likely to be appreciated in other parts of the province on account of its high yield and the outstanding quality of its *gur*. With the introduction into the general agricultural system of the three varieties, Co 299, Co 313 and Co 331 in North Bihar, the supplies of desirable raw material should be ensured from about the middle of November to the beginning of May. Co 312 and Co 346 appeared to be outstandingly good under Sabour conditions and Co 349 is reported to do extremely well in Orissa. The distribution of the latter variety, however, has been held up on account of its high susceptibility to mosaic. Preliminary work on differential spacing showed 2½ feet spacing between rows in the case of Co 299 to be the optimum distance and one that resulted in a significantly higher yield. The experiments conducted to find out the best method of keeping seed material in the case of early varieties showed the best results when material was left standing in the field and planted as soon after January as possible to avoid shooting due to rise in temperatures. Studies into burning trash in the field—a practice sometimes resorted to on account of inadequacy of labour—showed that though little damage may be done to burnt stalks during the first forty-eight hours in cold months, the loss was very appreciable if this practice is resorted to in spring. Other studies on botanical and physiological research included (1) germination, (2) growth-studies, (3) root-studies, (4) water-requirement and (5) breeding. Chemical research comprised of (1) general analytical work of sugarcane juice for the entire experimental crop, (2) sampling technique and (3) deterioration and dryage studies.

Manurial experiments showed 100 lbs. of nitrogen per acre to be the best dose for sugarcane under the conditions obtaining in Patna, while a combination of 40 lbs. N. and 50 lbs. $P_2 O_5$ was still found the most economical application in North Bihar. Anything more than 60 lbs. N. per acre is reported to be definitely uneconomical on heavy soils in South Bihar, while at Chota Nagpur 80 lbs. N. per acre gave heavy yields of sugarcane on the departmental farms.

Coimbatore canes in the PUNJAB continue to grow in popularity. During 1934-35 about 200,600 acres or forty-four per cent. of the whole sugarcane crop were planted with Coimbatore canes of various types. The following Coimbatore varieties were recommended by the Department of Agriculture, Punjab :—Co 285, Co 233, Co 213, Co 290, Co 281 and Co 205.

On the Agricultural Farms, a large number of varietal tests were carried out. Regular tests comprised :—

(*a*) Varieties maturing early in the season.
(*b*) Varieties maturing in the middle of the season.
(*c*) Varieties maturing late in the season.
(*d*) Varieties suitable for *gur*-making only.

Six early maturing varieties were tried during 1933-34. The experiment showed that Katha, which is supposed to be a very early cane, actually ripened after Co 221 and Co 313 and at the same time yielded poorly; Co 313 did best. Amongst five mid-season varieties tried, Co 213, the standard variety, did better than the others, but Co 347 did equally well and in addition ripened earlier than Co 213. Of the four late-maturing varieties tried, Co 300 was the best and gave a very high outturn. Co 312 stood second and is reported to be an excellent variety which made fine-quality crystalline *gur*; its sucrose percentage was also high. The only defect of this variety was its liability to lodge especially in heavily-manured fields. Experiments during 1933-34 on sowing sugarcane in trenches and on flat resulted in favour of the trench-sown crop and showed that the best distance from trench for the thin and medium canes generally grown in the Punjab was two feet. Regarding the ratooning of sugarcane it was found that Co 213 did not ratoon well but Co 223, Co 205 and Co 285 ratooned well for a number of years. It was found that whilst the outturn of cane is not lower in the Punjab than in the United Provinces and Bihar and Orissa, the sucrose content of Punjab canes is lower than that of these provinces. Investigations showed that the juice of Punjab canes contains an excessive amount of mineral matter and this may be responsible for the low nett rendiment of Punjab *gurs*. The mineral content of the juice of some of the chief varieties of cane grown in different localities was determined and the results confirm those of the year 1933-34, namely, that canes grown in the sub-montane tracts contain less mineral matter than those grown in south-western districts. It was found that the nature and amount of water-soluble salts in Punjab cane soils are not markedly different from those of the United Provinces and Bihar, but the amount of exchangeable calcium in the Punjab soils is lower and this may be one of the causes of inferiority of Punjab canes.

IN MADRAS comparative trials of several varieties of canes were in progress at the Anakapalle, Samalkota, Hagari and Palur Agricultural Research Stations. Observations were made on the root system of the most important varieties to pick out the best of the types that resist drought. Under dry conditions Co 213 and some of the sorghum-sugarcane hybrids develop a deep root-system and were able to withstand dry conditions remarkably well. Co 419 and Co 243 were also equally good in that respect. Studies of shoot development showed that Co 349 produced a high percentage of useless tillers. It was noted that wrapping had no influence on the growth of the cane. Growth measurements indicated that the maximum growth takes place in the rainy season and growth generally ceases by the end of October. At present, the crushing season is short in most of the cane-growing areas. In order to find out if cane can be successfully planted and harvested in two seasons, as in the Coimbatore and Madura districts, monthly planting trials were in progress at Anakapalle, Samalkota and Palur. The results at Anakapalle showed that there are two distinct planting seasons, February-April and September-November. Planting may also be done in the months of May, June and December, but the other months are unsuitable for planting. The canes begin to mature in the cold weather—those planted in February-April maturing in January-February, whilst those of the September-November planting mature in November-December of the following year. These results indicate that, by a suitable adjustment of varieties, the crushing can be started as early as 15th November and continued until the end of May. At Palur, the monthly planting trials showed January-April to be the best season for planting. An experiment to test the value of ratooning cane crop showed that the saving in the cost of cultivation was not commensurate with the loss of yield. It was also found that the saving in irrigation costs was very small compared to the loss in tonnage. Fairly good yields were obtained at Samalkota from Co 213, Co 281 and Co 285 planted under swamp condition. The manurial trials at Palur indicated that sodium nitrate is not as good as a mixture of ammonium sulphate and oil-cakes, while potash is unnecessary and the application of phosphate manures uneconomical.

The varieties J 247 and Purple Mauritius continue to be grown in the first circle, but Co 213 is becoming popular throughout the circle. In the second circle, Co 213, 243, 281 and P O J 2878 were popular. In the South Arcot district, Fiji B continued to be largely grown. The total area under all improved varieties of sugarcane in the Presidency was 40,262 acres.

BENGAL. In connection with the campaign to restrict the cultivation of jute, vigorous propaganda was undertaken by the Department of Agriculture, Bengal, to increase the area under sugarcane cultivation which is now estimated at 276,200 acres. Ten Coimbatore varieties of canes and one Dacca farm seedling cane have been introduced from the Cane Breeding Station into the Dacca Farm main area. The ryots are reported to be quite familiar with the high tonnage of cane and better yield of *gur*, both in quality and quantity, of improved Co 213 cane. The experiments conducted at the Government farms proved that Co 213 can be grown in transplanted paddy land. The cane survey map was revised during the year 1934-35.

The manurial experiment on Co 213 cane, started during the year 1933-34 at the Dacca Farm, has been continued with the ratoon crop. The results have confirmed the tentative conclusions arrived at during 1933-34 that an overdose of nitrogen prejudicially affects the quality of the juice.

At the Pyinmana Station in BURMA important experiments in the cultivation, choice of variety, manuring, ripening and storage of sugarcane are being conducted. This station has introduced to Burma some of the finest Java cane-seedlings notably P O J 2878 and 2727, which after repeated experiments have proved their undoubted superiority over the old indigenous varieties. On large-scale field trials, the former has yielded double the tonnage per acre of the hitherto widely-grown Pyinmana Red cane, *viz.*, forty-four tons against twenty-two tons, and has a sucrose content of approximately fourteen per cent. against twelve per cent. of the latter, while the only other local variety yielded even less. The second Java cane rivals its more famous relative. These canes by their vigour of growth, handsome appearance and heavy cropping capacity have made an immediate appeal to the cane-growers and the Department of Agriculture, Burma, forecasts the early disappearance of the old varieties, Pyinmana Red and Toungoo Yellow. Several other recent importations also surpass these older canes but the above two are easily the first. One promising seedling of P O J 2727 produced on the farm in 1931 was added to the variety trials and fourteen others were continued for further observation.

The results of fertilizer experiments during 1934-35 were consistent with the results of four previous years, that on the farm soil neither phosphate nor potash, up to fifty and sixty pounds per acre respectively, gave any measurable return in the weight of crop, sucrose-content or date of maturity, while sixty pounds nitrogen in the form of sulphate of ammonia per acre gave a crop increase of 14·5 tons on 34·7 tons control per acre equivalent to a forty-two per cent. increase. An experiment in which sulphate of ammonia was applied at approximately four, five and six cwts. per acre was not statistically conclusive but seemed to indicate that three cwts. is a satisfactory maximum.

An experiment in which the Java canes 2878, 2727, and 2714 were planted at monthly intervals from the 8th November 1933 to the 8th February 1934 appeared to indicate that the maturity of these depends not on time of planting but on climatic and soil conditions. Retention of one series of the variety trials and laboratory analysis up to May 1934 indicated that, of the fourteen varieties, only the following remained erect and sound at the end of April :—

P O J 2878, Co 363, Co 358 and E K 28.

In ASSAM, as ratoon canes, all the exotic varieties appeared to be significantly superior to the local variety Teli. The average outturn of these ratoons was 24·67 tons of stripped canes per acre, P O J 2878 giving the highest yield of stripped cane, followed in order by Co 361 and Co 290. Co 313 gave a slightly poorer outturn of stripped cane, but the quality of juice was the best. In plant canes (final varietal trials) the average outturn of both stripped cane and sucrose was poorer than usual. All the varieties, P O J 2714, P O J 2878, Co 290, Co 313 and Co 361 were found to be superior to Teli and Co 363. In plant canes (preliminary varietal trials), the varieties tested were all being tried for the first time. Co 408 appeared to be the best with regard to the yield of stripped cane and sucrose closely followed by Co 413, whilst Co 410 and Co 407 also appeared to be hopeful.

As a result of periodical analyses of juice, Co 409 was found to be somewhat early ripening and the quality of its juice was the best, followed by Co 365 and Co 360. Other new varieties were late ripeners and the quality of juice was in most cases poor. Of the *jowar* crosses Co 356, Co 351 and Co 357 were found to ripen early and to be superior to the rest. Sugarcane planting in October just after the close of the rains has been found to give higher yields than those planted in the normal season, the figures being as follows :—

	Lbs. of stripped cane per acre.
October planting	70,362
June planting	42,498
March planting	36,504

Of the varieties under trial at the Kopargaon farm in BOMBAY, the plant cane E K 28 gave the highest yield, while P O J 2878 gave the lowest yield. Of the ratoon canes P O J 2878 gave the highest yield and stripped D 109 the lowest yield of *gur* per acre. E K 28 did well as ratoon cane also. P O J 2878 was found to be little harder than E K 28 but it gave the highest brix reading in plant as well as ratoon cane. The sorghum-cane hybrids, *viz.*, Co 351 to Co 357 were planted at Belwandi but they did not seem to mature in less than eight months. At the Kumpta Farm Co 281, Co 290, Co 231 and H M 87 were compared with Red Mauritius according to Fisher's method. Red Mauritius was found to yield a higher tonnage than others.

In the final trials of sugarcane varieties during 1933-34 at the Padegaon Research Station (Bombay-Deccan), the following ten varieties were tested :—

P O J 2878, Co 290, Str. D 109, H 109, E K 28, Co 360, Co 402, H M 320, H M 89 and Pundia.

The soil in the block was greatly disturbed owing to scraping and deposition in the course of levelling ; consequently the germination was badly affected. The intense borer attack inhibited the growth in the early stages ; Coimbatore selections made up during the growing period and showed some important characters which require further corroboration. In another set of varietal trials, observations were made on the seven important varieties—Co 290, H M 320, E K 28, Pundia, Co 360, P O J 2878 and Co 402 at different stages as regards germination, number of tillers and number of canes at harvest (millable canes). It is too early to draw any conclusions from these experiments. Preliminary trials of new seedlings included five from Coimbatore and four from Hebbal, Mysore and supplied information on relative growth, sucrose and earliness. Co 416, Co 419 and H M 606 and 609 showed promise. Six sugarcane-sorghum hybrids were received from Coimbatore together with Co 281. As the material was extremely limited, on these ripening tests only were made with planting at two periods, *viz.*, February and June. The growth was normal for the February planting but stunted for June planting. None of the strains showed the maximum purity at six months under the Deccan conditions. In the intermediate trial of cane varieties, five varieties received in the year 1931-32 from Coimbatore were tested. The varieties Cos 403, 404, 405 and 406 showed promising performances.

Experiments on the nitrogenous requirements of cane were continued at the Kopargaon Farm. The results of the year 1933-34 showed that there was a progressive increase in the yield of plant and ratoon cane with the increase of nitrogen per acre, but there was not much difference in the yields of cane and *gur* of ratoon cane top-dressed with 150 lbs. and 200 lbs. nitrogen per acre respectively.

Experiments on the manurial requirements of sugarcane are in progress at the Sugarcane Research Station, Padegaon. The experimental plots were laid out on medium soil, the layout being as follows :—

Treatment.	Variety.
(1) 150 lbs. N.	Pundia.
(2) 150 lbs. N.	P O J 2878
(3) 300 lbs. N.	Do.
(4) 50 lbs. N.	Do.

It was found that applications of varying amounts of ammonium sulphate had practically no effect, either on the rate or the total percentage of germination. The rate of increase of dry weight was different for each variety. While Paunda was highly susceptible to atmospheric factors, especially humidity, P O J 2878 appeared to be much more independent of external environment. The relative efficiency of the 50, 150 and 300 lbs. nitrogen treatments from the standpoint of yield was worked out to be 0·8 : 1 : 1·5. It was found that the 50 lbs. nitrogen treatment fell short of the requirements of the sugarcane crop. It was also found that plants receiving lower doses of nitrogen ripened earlier. A study of the periodical development of the root-system showed a definite gradient from lower to higher doses of nitrogen. An examination of the intake of mineral nutrients indicated that the intake was very little during the formative stage and very high during the grand period stage. As regards the relative importance of the main elements from the standpoint of intake, potash came first and phosphates last. From the manurial standpoint, however, nitrogen and phosphates were found to be the most important.

Other important studies on the sugarcane crop at Padegaon consisted of (i) significance of some of the physical properties of cane soils, (ii) harvest data and botanical observations, (iii) nitrification and nitrogen-recuperation in soils, (iv) bioclimatic study, (v) water-requirements of sugarcane, (vi) relation of water to manure and (vii) study on the quality of *gur*.

NORTH-WEST FRONTIER PROVINCE. Early, medium and late canes, which are resistant to frost and which produce a good quality of *gur*, are the chief requirements of the province. The following varieties are under trial at Tarnab :—

Paunda, Assam Red, Co 400 to Co 405, Co 410 to Co 412, Co 213, Co 223, Co 285, Co 358 to Co 364 and Co 290. Of these the most promising varieties are :—

Co 290, Co 285, Co 360, Assam Red, Co 223 and Co 361 to Co 363.

Some setts of Cos 290, 285 and 213 were planted in the month of November and came up well. This opens up the possibility of sowing the next year's crop at the same time that the cane is harvested. It is reported that it would result in a great economy, firstly, in the labour employed in clamping and, secondly, in the avoidance of the loss of setts in the clamps. Experiments carried out at Tarnab indicated that by using the tops as seed some saving was effected while it was found uneconomic to use the tops as cattle fodder. It is the practice of the zamindars to pay for the labour of cutting the cane by the gift of the tops to the labourers to be used as cattle fodder. The crops grown from tops, however, showed no superiority over that propagated from whole cane.

Results of the manurial experiments at the Tarnab farm during 1933-34 showed that higher yield is obtained by the application of 50 lbs. of $P_2 O_5$ and 80 lbs. of nitrogen in comparison with 40 and 60 lbs. of nitrogen, keeping the quantity of $P_2 O_5$ the same. In the case of 75 lbs. of $P_2 O_5$ alone and with 40 lbs., 60 lbs., and 80 lbs., of nitrogen, higher yield was obtained from the plot receiving 75 lbs. $P_2 O_5$ and 80 lbs. of nitrogen, while in another set of experiment with 100 lbs. $P_2 O_5$ with 40 lbs., 60 lbs. and 80 lbs. of nitrogen respectively, highest yield was obtained with 100 lbs. $P_2 O_5$ *plus* 80 lbs. nitrogen.

5. Jute.

The total area under jute in the three provinces of Bengal, Bihar and Orissa and Assam, during 1934-35, was 1,947,000 acres as against 2,670,100 acres of the previous year, or a decrease of over twenty-seven per cent. This was the result of an intensive campaign inaugurated by Government to persuade cultivators to restrict the area under jute on account of the continued slump in the jute market. Unfavourable weather conditions at sowing time were also partly responsible for the reduction in area. All available Government agencies, including the officers of Bengal Agricultural Department, were engaged in propaganda work advising cultivators as to the crops which could replace jute, and in distributing seeds. Substantial help was also received from non-official sources. The East India Jute Association, Ltd., and the Calcutta Hessian Exchange Ltd., contributed Rs. 2,500 and Rs. 2,000, respectively, for the purchase of seed of alternative crops. Government also sanctioned the free distribution of a large quantity of sugarcane cuttings. Some of the District Boards also provided funds for the purpose.

The area under jute in Bengal was 86·1 per cent., in Bihar and Orissa 7·3 per cent., and in Assam 5·5 per cent., of the total area under jute in British India. The total outturn of jute for the three provinces during the year 1935 was 6,395,700 bales of 400 lbs. against 8,525,500 bales in the previous year.

Excepting during the early part of the season (1934-35), sowings in BENGAL were generally carried out under favourable circumstances. During the period of harvest, conditions were on the whole favourable in East and North Bengal. In West Bengal insufficient rainfall and insect attacks affected the crop in places. In BIHAR AND ORISSA, the weather conditions were fair to good excepting in the most important jute district of Purnea, where rainfall during July and August was much below the normal. In ASSAM heavy rainfall and local floods affected the outturn, specially in the low-lying areas. Insects too caused slight damage in some localities.

Seed of departmental races continued to be sold through the Government selling agent, Narayanganj. The germination of 337 maunds of seeds for sale was tested by the Fibres Section of the Bengal Agricultural Department.

The departmental type D 154 continues to be unrivalled both in regard to yield and quality of fibre. The experiments conducted in collaboration with the jute trade over the last 11 years to arrive at a conclusion regarding the quality of Departmental races gave results which are of particular interest. The votes of the assessors over the period are given below :—

D 154	351
Fanduk	351
Local	287
R 85	268

The average yields per acre of these types of jute over this period are as follows :—

	Mds.	Srs.
D 154	19	1
Fanduk	16	1
Local	15	29
R 85	17	33

The breeding work on jute continued and, whilst D 154 has the best average in the test plots, " X early " gave the best yield at Rangpur —32 maunds per acre—whilst D 386 gave the best yield at Dinajpur —32 maunds 20 seers per acre.

Prices of jute continued to be low. With the announcement by Government that a restriction campaign on an intensive scale would be launched, prices improved from December 1934. The average price paid for jute from July 1934 to November 1934 was Rs. 3-6-10 per maund, whilst the average price paid in December was Rs. 4-4-2. Prices in Calcutta for middle marks for the period April 1933 to November 1934 averaged Rs. 4-1-0 per maund. For the period December 1934 to March 1935 the average rose to Rs. 5-2-0 per maund.

6. Other Fibres.

Hemp. Selection work was in progress at the Botanical section at PUSA. Some promising fixed hybrids from the crosses, New

Hibiscus×*Albus* and *Hibiscus* ×*Ruber* were grown and specimens of a few of these were sent to the Fibre Expert to the Government of Bengal, Dacca, for preliminary fibre tests.

The F_2s of the crosses, New *Hibiscus* (*H sabdariffa* var *altissima*) and *Albus* and New *Hibiscus* and *Ruber* were repeated in order to carry on some red stemmed plants, selected at random to the F_3 generation to corroborate the previous F_3 results relating to the inheritance of stem colour.

The F_2s of crosses between varieties *Albus* and *Ruber* and between *Ruber* and New *Hibiscus* were grown to study the effect of time of fertilization of F_1 plants on the phenotypic segregation in F_2. The results did not indicate that the age of F_1 plants had any influence on the phenotypic segregation in F_2.

The F_2 of a cross between an early, short variety and a late tall variety of *H. cannabinus* L was grown to study the inheritance of number of days required for flowering and height of plant. The results indicated that probably a number of cumulative factors determined each of the characters. The F_3 might throw more light on this.

Sunn-hemp. (*Crotalaria juncea*). The following figures show the export trade of India in raw hemp during the last three years :—

Year.	Cwts.	Value (Lakhs of Rs.).
1932-33	281,000	32
1933-34	388,000	36
1934-35	437,000	39

At Pusa, notes on morphological and economically important characters of single plant cultures were taken. A large number of these cultures were raised from single plant seed collected from different parts of Bengal and work was started in collaboration with the Assistant Fibre Expert in charge of the Fibre Section, Dacca, Bengal, with the object of evolving strains suitable for Bengal.

A sample of fibre of linseed T 124 was sent to the Imperial Institute, London, for opinion. The preliminary tests indicated that the fibre, though coarse, might find a good market in England.

BOMBAY. The results of the experiments on Fusarium wilt in sunn-hemp showed that the fungus had been traced to the pods and that the seed was thus an important factor in the dissemination of the parasite. Further experiments were in progress.

BENGAL. Sunn-hemp in Bengal is normally a *rabi* crop but in Western Bengal it is a *kharif* crop. Cawnpore 12 was undoubtedly superior to other types tried as a *kharif* crop, but as a *rabi* crop it was a failure. The presence of dirt and stick lowers the value of the fibre. A simple scutching device was introduced by means of which the fibre could be cleaned and straightened at small expense and little loss of fibre.

UNITED PROVINCES. (*a*) Comparative trials of fibre yield between improved strain Cawnpore 12 and the local variety conclusively proved the superiority of the former, and the difference was statistically significant.

(*b*) Seed-rate experiments were continued during the two years under report and definitely proved that 80 lbs. seed-rate per acre with ninety-five per cent. germinations is adequate to obtain good fibre yield.

(*c*) As a result of experiments on the proper stage for retting, it was found that the retting of the crop, when it was in full bloom, gave the highest yield (840 lbs.) and the best quality fibre.

(*d*) Three to four days steeping of the material in clean and very slowly flowing river water in October was found to be sufficient.

(*e*) The improved method of retting, in which bundles of stalks, from which root and terminal leafy portions have been removed, are tied to a bamboo frame and steeped in water, was found to give a white, lustrous fibre free from dirt.

(*f*) Small scale experiments on the extraction of the fibre from retted material by manual labour and by hand and power machines were made at the Government Research Farm, Cawnpore, with the following result :—

(*i*) Extraction by the existing hand machines involved considerable labour and time and the cost entailed was almost double that of extraction by manual labour.

(*ii*) Using a power-driven flax breaker alone the cost of extraction was higher than with hand labour, though lower than with hand-driven machines, on account of the cost of removing the broken sticks but the extraction was quick.

(*iii*) Using power-driven scutching and dressing parts of the machine also the extraction would be still quicker and the cost would be reduced.

BIHAR AND ORISSA. Seventeen samples of sunn-hemp obtained from different localities in the province were grown and studied. At Sabour it was found that certain bees (*Xylocopa amethystina* Fabr., *Megachile anthracina* Sm. and *M. lanata* Fabr.) brought about cross-pollination in sunn-hemp. These bees were let loose into the bagged flowers and they started the process of pollination. As a result of this, the setting of selfed seeds and fruits was ensured.

The following tentative conclusions were arrived at :—

(*a*) The highest fibre yield was obtained with a seed-rate 60-90 lbs. per acre.

(*b*) Stagnant water was better for retting than running water.

(*c*) The dry method of extraction was proved to be superior to wet method.

(*d*) In stagnant water, sticks retted from 4-6 days gave the best results.

(*e*) The proper stage for harvesting the *deshi* (early) class of sunn-hemp was the green pod stage, while for parwaria (late) class, retting a little before flowering yielded the best result. From the point of view of yield, Bihar Sharif was proved to be the best variety ; for lustre, the local (*deshi*) variety was the best and for uniformity, Nawadah and Bihar Sharif varieties were the best.

7. Tobacco.

The total area under tobacco in India was 1,251,000 acres in 1932-33, 1,227,000 acres in 1933-34 and 1,350,000 acres in 1934-35. The total yield of dried leaf was 616,000 tons in 1932-33, 561,000 tons in 1933-34 and 671,000 tons in 1934-35. The bulk of the tobacco is consumed in the country. There is also a valuable export trade in unmanufactured leaf, as will appear from the following figures.

Export of unmanufactured tobacco.

Year.	Quantity in million lb.	Value in lakhs of Rs.
1932-33	21	73
1933-34	29	90
1934-35	26	78

During 1934-35 there was a ten per cent. decrease in respect of the quantity of the export and thirteen per cent. in respect of value. The United Kingdom continued to be the best market for Indian tobacco which enjoys a preference in that country, which took thirteen million lbs. in 1933-34 and nine million lbs. in 1934-35.

The clearances from Bond of British Indian tobacco, however, which are a better indication of the United Kingdom consumption, were as follows :—

	Lbs.
1932	9,380,191
1933	9,487,265
1934	9,567,237
1935	9,811,355

The extent to which the imports of ready-made cigarettes into India have declined is shown in the following table :—

——	Import of unmanufactured tobacco in million lbs.	Import of cigarettes in million lbs.
1922-23	1¼	4
1923-24	4½	3·5
1924-25	7	2·75
1925-26	4	3·4
1926-27	5¾	4·2
1927-28	4	5·6
1928-29	6¾	5
1929-30	4½	5·3
1930-31	1½	3·1
1931-32	2·8	1·4
1932-33	5·1	0·8
1933-34	4·2	0·59
1934-35	3·0	0·61

The decrease is to be attributed to the increase in the production of flue-cured and other types of cigarette tobacco in India as the imports of unmanufactured tobacco into British India do not show any appreciable rise over those of ten years ago.

The number of flue-curing barns in operation worked on the principles evolved at Pusa now exceed 2,000. At PUSA during 1933-34 the large growings of type 142 tobacco for flue-curing produced a fine crop and some very good-quality leaf was cured before the crop was damaged by hailstorm on January 13th. Owing to this disaster it was not possible to save enough seed for distribution. During 1934-35 plants of hybrid 142, Adcock and Harrison's Special was raised in large quantities for the supply to the provinces, in connection with a co-operative scheme financed by the Imperial Council of Agricultural Research, to determine what areas in India are suitable for the cultivation and curing of cigarette tobacco.

Tobacco-soils from Saharanpur in the United Provinces, Guntur in Madras and Dacca in East Bengal were obtained for study. The chemical examination of eight samples of tobacco soils obtained from the Kaira district in Northern Gujarat was completed. Almost all the soils were found to be rich in nitrogen potash and phosphate contents, the available phosphate in most cases being unusually high. Observations on seed-setting in Pusa type 56 tobacco, and in Type 63 indicated that the poor capsule formation of the former at the low temperatures prevailing in December and January, was caused by the defective functioning of the pollen at such temperatures.

An important scheme of tobacco research was worked out by a special committee of the Imperial Council of Agricultural Research during 1934. This includes co-operative experiments in the various provinces to determine the areas suitable for cigarette tobacco production and the factors determining quantity, and a tobacco sub-station at Guntur. Funds have since been allotted and work is being started.

In the MADRAS Presidency tobacco is grown in two distinct tracts—Guntur and Trichinopoly. At Guntur the work of crossing and selection on this crop was continued. Selection 13 was decidedly the best and gave a twenty-two per cent. increase over local Virginia in the comparative trials.

The results of the manurial experiment showed that the best yields were obtained by giving the crop complete fertilizers with a basal dressing of cattle manure at four cart loads per acre every year.

Among the various treatments tried for controlling the " damping off " disease of tobacco-seedlings, the burning of trash on the ground before the seed was sown was found to be the cheapest and the most effective.

In the BOMBAY Presidency there are 3,533 acres under the improved tobaccos 6 and 28. In the Ratnagiri district, Nadiad 28 and Adcock varieties of tobacco were tried as semi-*kharif* crops without irrigation at 16 centres and the results were encouraging. On the creep side, the crop yielded 1,600 lbs. with four waterings and was found more economical than the cultivation of brinjals and chillies.

The Plant Pathologist to Government of Bombay has found that ordinary tobacco-mosaic virus passed from the upper into the lower epidermal cells in sufficient concentration to be detected thirty-six to forty hours after inoculation of a well-developed leaf of *N. sylvestris*.

The effect of dilution on the thermal death-rate of ordinary tobacco-mosaic virus was determined by means of the local lesions method. The thermal death-point of the virus was close to 70°C. at a dilution of 1 in 10,000.

In SIND the tobacco crop, which is an important money crop for the Barrage areas, was severely damaged by frost in 1933-34, and by mosaic disease in 1934-35. Eight varieties from Pusa, Guntur and Nadiad were sown for testing their suitability to local conditions, Gandiu 6 and local Mastoongi were grown on a field scale.

In BENGAL work on tobacco was continued at the Government Farms, Rangpur and Dacca. The areas under tobacco, in districts other than those in the Northern Bengal tobacco tract, continued to increase. Tobacco was one of the few crops which did not suffer from depressed prices. The cultivator in the jute-growing areas was growing his own tobacco instead of purchasing leaf as he did when jute prices were remunerative. During 1933-34 a wide area in the tobacco tract was severely affected by hailstorms.

During 1934-35, 3,069 tolas of *deshi* and fifteen tolas of exotic seeds were distributed. Demonstration of Matihari tobacco was continued throughout the provinces. *Bidi*-tobacco was manufactured at the Dacca Farm and leading *bidi*-merchants in Dacca were stocking Bengal-grown *bidi*-tobacco.

In the PUNJAB type 12, which is of the *huqqa* type, was tried extensively at Jullundur, Montgomery and Lyallpur, and at all places considerably outyielded the local varieties. Type 57, and important selection of the cigarette class, yielded well in all trials. As part of a scheme which includes other provinces, the Imperial Council of Agricultural Research provided funds for the erection of two tobacco flue-curing barns in each province with the object of ascertaining the possibilities of producing good cigarette tobaccos. The lack of such barns hitherto has hampered the development of tobacco research.

BIHAR AND ORISSA. Pusa 28, Hingli, Motihari, Pusa 177 and local were compared. Pusa 28 gave the highest yield. Pusa 177, which was the highest yielder during 1933-34, became third in the order of merit in the succeeding year. Manurial experiment during 1933-34 showed that potassium nitrate gave the highest yield. During 1934-35 castor-cake gave the best results.

NORTH-WEST FRONTIER PROVINCE. At the Tarnab Farm tobacco was grown in 3·75 acres and yielded at the rate of 13 maunds 26 seers (Peshawari) leaf and 6 maunds and 26 seers stalk.

8. Oil-Seeds.

The Imperial Council of Agricultural Research sanctioned temporary financial assistance of Rs. 30,000 during 1934-35 to the Harcourt Butler Technological Institute to enable the Government of the United Provinces to continue the Section of Oil Technology in view of the importance of the vegetable oil industry to the Indian agriculture. In return, the Institute agreed to admit to the Oil Section of the Institute, free of all fees, seven scholars nominated by the Council from other provinces—five for the diploma course and two for a short term oil course.

In view of the importance of the castor crop in the H. E. H. the Nizam's dominions—which contain about one-half of the total acreage under this crop in India—the Council sanctioned a grant of Rs. 61,000 spread over a period of five years for research work on the improvement of this crop. Work was started in April 1934.

As a result of recommendations from the Oil-Seeds Committee and the Advisory Board, the Council issued weekly circulars containing useful information regarding the linseed trade in India and abroad. The Council issued also, for the use of oil-crushers in India a pamphlet containing information regarding the standards of quality required by the London and continental markets for certain oils and oil-seeds.

The question of encouraging cotton-seed crushing in India was considered by the Oil-Seeds Committee and it was pointed out that one difficulty which lay in the development of this was the regular disposal of the cake for which there is no adequate demand in India. The provincial departments of agriculture were addressed on the possibility of creating a demand for decorticated cotton-cake by means of extensive experiments in departmental farms, propaganda and demonstration. If there is sufficient demand for cotton-seed cake for these purposes, arrangements for the installation of a decorticator at the Harcourt Butler Technological Institute for the supply of decorticated cotton-seed cake for experimental and demonstration purposes will be made.

The estimated area and yield of the principal oil-seeds in 1933-34 and 1934-35 as compared with 1932-33 are shown in the following table :—

—	1932-33.		1933-34.		1934-35.	
	Area in thousands of acres.	Yield in thousands of tons.	Area in thousands of acres.	Yield in thousands of tons.	Area in thousands of acres.	Yield in thousands of tons.
Rape and mustard .	6,094	1,042	6,034	943	5,332	900
Linseed . . .	3,299	406	3,261	376	3,381	418
Sesamum . . .	6,256	551	6,307	541	5,222	408
Groundnut . .	7,409	2,997	8,226	3,330	5,788	1,896
Castor . . .	1,617	151	1,534	143	1,450	106
Cotton-seed . .	..	1,626	..	1,839	..	1,741

In 1933-34 the production of cotton was 5,108,000 bales and the output of cotton seed calculated at 0·36 ton per bale may be estimated at 1,839,000 tons. Similarly, in the succeeding year 4,836,000 bales correspond to 1,741,000 tons of cotton-seed. The exports of oil-seeds have, on the whole, decreased, since the war.

Groundnut is an important exception, the marked increase being due to an increase in area. In 1933-34 there was a remarkable increase in the exports of linseed.

Exports of oil-seeds in thousands of tons.

——	Pre-war average.	1932-33.	1933-34.	1934-35.
Linseed	379	72	379	238
Rape and mustard	277	119	76	40
Groundnut	212	433	547	511
Castor	114	86	82	69
Cotton seed	240	2	6	1
Sesamum	119	10	15	4
Others	102	5	11	3
TOTAL	1,443	727	1,116	866

The exports of oil-cakes and vegetable oils have also increased, but the increase in the quantities of oil-seeds crushed for local consumption is still more striking, especially in the case of groundnut oil which is largely used for the manufacture of vegetable *ghi* as well as for domestic consumption, soap-making and general industrial purposes.

Exports of oils and oil cakes.

——	1932-33.	1933-34.	1934-35.
Vegetable oils in gallons	2,444,000	2,987,000	2,176,000
Oil-cake in tons	287,000	287,000	348,000

Rape and mustard. Almost half the acreage of these crops in India is in the United Provinces (2·7 million acres), the other important provinces being the Punjab (0·7 million acres), Bengal (0·72 million acres), Bihar and Orissa (0·60 million acres) and Assam (345,000 acres). In the Punjab improved pure-lines of rape and mustard yielding a higher oil-content by two to five per cent. and giving better yields by over a maund per acre have been isolated. Hybridization has resulted in abundant material which, it is hoped, will give improved strains capable of setting well even in cloudy and rainy weather when pollination is hindered owing to insects not visiting flowers. In the meantime, drill-sowing has been found to increase yields. In the United Provinces and Bengal selection of strains is continued aiming at high yield, higher oil-content and aphis-resistance. Over five-thousand demonstrations of *sonai* mustard were carried out in Assam.

Linseed. The area under linseed is about 3·4 million acres, chiefly in the Central Provinces and Berar 0·97 million acres, United Provinces 0·86 million acres, and Bihar and Orissa 0·59 million acres. At Pusa extensive investigations have been carried out with the object of producing a white or yellow seed of high oil-content and good yielding capacity. The types of linseed, however, which grow and yield well in the Gangetic plain are the small-seeded types, and with the object of producing a large-seeded type capable of good yield in the Gangetic alluvium, crosses have been made between small-seeded types which grow well in Northern India and the "bold"-seeded types which grow well in peninsular India. Numerous hybrids have been produced of high oil-content and medium seed size.

Realizing the benefit of the Ottawa preferences to Indian linseed, the Provincial Agricultural Departments have made considerable headway in intensifying research on linseed and in demonstrating to the cultivator that linseed is a valuable alternative crop. In Bengal linseed is recommended in places of jute. In Bihar and Orissa a wilt-resistant linseed type—Sabour 6—was crossed with Pusa types 12 and 121.

In Burma this crop is a promising one for sowing after the harvest of paddy. In Bombay, local varieties were found better than any of the types from other provinces. In Mysore, seven Pusa varieties were tried and, of these, hybrid 21 and type No. 124 were found to yield best. In the Central Provinces the crosses between the local linseeds, and the wilt and rust-resistant American, Morrocco, and

Russian flaxes were made: and the strains are being isolated. An improved strain E. B. 3, which yields 30 per cent. more than the standard, has been obtained by hybridization. In the United Provinces, the year 1933-34 was characterized by heavy rust epidemic which afforded a thorough test of susceptibility. The Cawnpore types 1150, 1193, 1196, and 1206 which combine high yield and oil-content remained free from rust. Experimental work in the utilization of linseed straw for industrial purposes shows that this material has commercial possibilities which will greatly add to the value of the crop.

Unfortunately any increases in the area sown with linseed are unlikely to come to light except after some time. Bengal and Bihar being permanently settled provinces, there is always an element of doubt, regarding their crop areas. In the United Provinces linseed is grown mostly as a mixed crop, the area actually under linseed being calculated by a formula which does not allow for any increase in the proportion of one constituent of the mixture.

Sesamum. At Pusa, pure lines of sesamum have been isolated and these have been supplied to the Provinces. The causes for phyllody prevalent in sesamum are being investigated. From a trial of thirty-five types in the Central Provinces, it appears that white-seeded varieties are better yielders and possess higher oil-percentage. In the principal sesamum-growing province, Burma, more " green flowering " was found to occur in the earlier sowings than in the later ones. The stems of late sesamums were attacked by a fungus *Phoma.* The sowing of sesamum in lines made with a harrow results in the saving of seed by fifty per cent. and the reduction in the weeding expenses by half. Additional saving in the expenditure was demonstrated by the use of the " square " method of sowing. Among the early sesamums, the selection E-25-187, showed that the highest oil-content 56·78 per cent. on dry matter. None of the Pusa types did well under the conditions prevailing in Burma. The local varieties were crossed with the Palestine ones. Some interesting and important experiments on photo-periodism of sesamum were carried out. The attempts to vernalize early and late varieties failed.

In Madras, a number of pure lines were isolated and tested for their yield. The residual effect of manuring the previous crop was marked on sesamum. A spacing of 12″×12″ was found to be the most economical.

Groundnut. The area under groundnut decreased in 1934-35. This is doubtless due to the fall in the prices of groundnuts and relative improvement in the prices of cotton. India is now the largest producer and exporter of groundnuts in the world, as well as the largest consumer. Production in India had increased both steadily and rapidly, and it is not improbable that the 'peak' area of 1933-34 was too large to be readily absorbed. The principal areas in which this crop is grown are Madras with 2·4 million acres, Bombay with 0·89 million acres and the Hyderabad State with 0·96 million acres in 1934-35.

In MADRAS a new station for research on oil-seeds was opened at Tindivanam during 1935. The improved variety A H 25 was distributed for the first time. This variety is drought-resistant and yields about 15 to 20 per cent. more than the local spreading varieties. Inter-specific hybridization was carried out between *Arachis hypogoea*, the commonly cultivated groundnut, and *A. nambyquarae* and *A. rosterio*, two Brazilian wild species. Viability tests showed that under ordinary storage, groundnut loses viability in about two years. The manuring of groundnut with cattle manure has been found profitable even when the prices are low. The correct spacing for the spreading variety is found to be 9″×9″ and that for the bunch 6″×6″.

In BOMBAY, the Spanish peanut 5 continued to find favour and about 120,000 lb. of seed were distributed in 1933-34. The Spanish peanut forms a good rotation in the cropping scheme. In three year rotations, tobacco-*jowar*-cotton gave better results than groundnut-*jowar*-cotton. In two-year rotations, however, groundnut-*jowar* is better than tobacco-*jowar* or cotton-*jowar*. In the seed rate experiments, 60 lb. seed-rate was found less profitable, but there was little difference between 80, 100 and 120 lb. seed-rates. Under the jute restriction scheme in BENGAL, the cultivators were recommended to grow groundnuts as an alternative crop and as a result there has been a growing demand for seed. In the varietal trials Madras type A H 24 was found to be the best. Pondicherry and Big Japan varieties did well in South Bihar. Groundnut seed is in demand in Chota Nagpur. In Mysore *ragi* after groundnut yielded eighty-eight per cent. more than *ragi* after *ragi*. Experiments on the use of groundnut oil as a substitute for casein in Bordeaux mixture, carried out on a large scale, proved that the oil mixture was more effective than even the casein-mixture. In the CENTRAL PROVINCES and BERAR, the strains A K 10 and A K 12-24 continued to find favour and a new strain A K 8-11 was found promising. In the United Provinces selection work is in progress with a view to develop early varieties which can be harvested in irrigated areas and which will allow of the preparation of the land for the *rabi* crop. In the PUNJAB, the variety A 2 gave the highest outturn in Ludhiana district. The cultivation of the groundnut has been initiated in the North-west Frontier Province where the strain A K 10 appears to be doing well. In BURMA it was found that as regards oil-content soil differences were more important than varietal differences.

Castor. More than half the area under castor is concentrated in the Hyderabad State (786,000 acres), the next important province being Madras with 278,000 acres in 1933-34.

In the Hyderabad State selections have been made which are superior with regard to oil-content and yield. In Madras high-yielding inbred lines have been evolved and the botanical classification of castor types was completed. Russian varieties did not compare favourably with local ones. Attempts are being made to isolate pure lines in the Central Provinces, the United Provinces and the Punjab. In Bombay, the pure lines were tested with local varieties at Nadiad and the suitability of different strains to various seasons and tracts was determined.

Coconuts. In Madras work was continued on manurial, varietal distance and depth of planting trials. About 1,000 seedlings obtained by hybridization, selfing and natural pollination were planted at Nileshwar. Germination and root studies and investigations on floral biology were carried out. The incidence of shoot-rot was the least in the plot manured with potash. In 1933-34, 8,573 seed-nuts and 1,385 seedlings, and in 1934-35, 9,905 seed-nuts and 147 seedlings were distributed.

Cultural and manurial demonstrations and experiments were carried out in Travancore State. Manurial experiments on the coconut research stations are in progress in Orissa, Burma and Mysore.

Soy-beans. Investigations to determine whether soy-beans can be grown profitably and, if so, the variety best suited for the particular tract are in progress in the Punjab, Sind, Bihar and Orissa and Baroda State.

Safflower. The isolation of pure-breeding, spineless varieties of safflower is in progress in Bihar and Orissa. The distribution of Pusa types is being continued.

Tung oil. In Burma the tung oil tree *Aleurites Fordii* was badly attacked by the fungus *Diplodia Theobromae,* whereas *A. montana* is free from the disease. The extent of cultivation of tung oil and the possibilities for its expansion were enquired into by the officers in Burma, Assam and Madras.

African oil-palm. At the Mudon Agricultural Station, Burma, the African oil-palm showed vigorous growth and the average percentage of oil in dry pericarp of the palm fruit was found to be 75·75. On the west coast of Madras at Nileshwar, oil-palm seedlings were planted for trial.

9. Tea.

The area under tea in India was :—

——	1932.	1933.	1934.
Area in acres	809,500	817,800	822,700
Production (lbs.) (black and green)	433,669,300	383,722,200	398,568,000

Seventy-six per cent. of the total area under tea in India lies in Assam (in the Brahmaputra and Surma Valleys) and in the two contiguous districts (Darjeeling and Jalpaiguri) of Northern Bengal. The elevated region over the Malabar Coast in Southern India (including the States of Travancore and Cochin and the British districts of Malabar, Nilgiris and Coimbatore) contains 19 per cent. of the total.

Of the total area of 820,700 acres, for which either returns or complete estimates have been received, 765,500 acres were reported to have been plucked during the year, as against 755,300 acres in the preceding year. On the remaining 55,200 acres, the plants were either too young to be plucked or were not plucked at all.

During 1933-34 the rainfall was badly distributed and the season was characterised by a series of droughts followed by deluges. This fact, coupled with the export restriction scheme in force, resulted in a reduction of the output. The general quality of tea produced was good average. The average price per lb. realized at public auction during the year was 0-9-7 for tea sold with export rights and 0-4-10 for tea sold for internal consumption.

During 1934-35 heavy rains were experienced up to end of May in almost all tea-producing centres in North India. There was very little outstandingly good quality tea produced during the season, though the standard on the whole was good, except towards the end of the season. Heavy floods in June and unusual late rain in November proved detrimental to the production of good quality second flush and autumnal teas. The International Scheme for the Regulation of the Exports of Tea to which India is a party came into operation in April, 1933. The object was to check over-production and to maintain a more reasonable level of prices. The export quota allotted for 1933-34 was fixed at 85 per cent. of 1929-30 (the standard year) and raised to 87½ per cent. for 1934-35 but, on the advice of the International Tea Committee, has been reduced to 82½ per cent. for 1935-36, as stocks in London had increased to an undue extent.

The *Indian Tea Control Act*, 1933, regulates the amounts of tea that can be exported from India, but does not control the total amount of tea that can be produced. The difference between the total amount produced and the amount that is exportable is the amount that is available for the Indian market. It can readily be appreciated that this uncontrolled amount might assume such a size as to flood the Indian market with a resulting drop in the price paid for the tea. This is recognised by the tea industry, 90 per cent. of whom have entered into a voluntary agreement to a limited total production.

The application of restriction to the tea industry has resulted in many gardens being able to produce the permissible crop from a smaller acreage than they are at present cultivating. This has resulted in throwing out of commission the poorer producing areas and obtaining the crop from the areas producing the greater crop. The poor areas so thrown out of commission are being replanted with new and better plants so that in a few years time, when these plants become mature, such areas will have a considerably greater potential producing capacity, by which time it is hoped that tea production and consumption will once again be approaching equilibrium. The control scheme has a very elastic organisation which permits of its operating under all conditions, and ensures that the amount of tea that can be exported to the different world markets shall bear a reasonable proportion to the demand, thus materially helping towards stabilising market conditions.

As may be expected the working of the restriction scheme has resulted in bringing into prominence certain considerations that reflect on the economics of tea production, such as the desirability of producing a large crop from a small area so as to reduce costs and also the production of the best quality owing to the limitation of total crop. It is therefore of special interest to study the experimental data that have been obtained at the TOCKLAI EXPERIMENTAL STATION which is able to assist growers in formulating their policy in regard to such considerations.

The production of crop can be influenced by several cultural operations of which an important one is manuring. Experiments at Tocklai have shown that the manuring of tea with a mixture containing nitrogen, phosphoric acid and potash gives increased crop. The unmanured area gave 7·7 mds. of tea per acre, whereas the area manured with 40 lbs. nitrogen per acre, gave on an average 12·7 mds. per acre. This experiment, however, clearly showed that it was the nitrogen that was responsible for the great increase, for nitrogen alone gave an increase of 4·68 mds. of tea per acre at a cost of Rs. 11-7-0; whereas the addition of 60 lbs. of phosphoric acid and 60 lbs. of potash together costing Rs. 20 gave a further addition of only 0·85 mds. per acre. Smaller doses of both phosphoric acid and potash gave no significant increase in crop over nitrogen alone. It must then be assumed that the soil provides sufficient phosphoric acid and potash for the crop produced by the use of 40 lbs. of nitrogen per acre annually as manure.

Consideration, however, must be given to the quality of the tea produced, and there are indications which do not amount to definite proof that the phosphoric acid has improved the quality and that potash has lowered the quality slightly. The effect of using phosphoric acid as a manure is to raise the phosphoric acid content of the leaf, and the use of potash also increases the potash content of the leaf.

Since nitrogen is the important constituent of the manure, it is of importance to know the effect of using different quantities of nitrogen as a manure.

The results of the experiment that has now been continued for six years, using nitrogen in the form of sulphate of ammonia for two years and calcium cyanamide for one year to avoid complications due to change in soil acidity, indicate that the increased crop obtained is approximately proportional to the increase in the amount of nitrogen added.

	Maunds.
40 lbs. of nitrogen have given an increase over the unmanured check plot of	3·82
80 lbs. of nitrogen have given an increase over the unmanured check plot of	8·26
120 lbs. of nitrogen have given an increase over the unmanured check plot of	11·14

This result is obtained whether the manure is added in one dose in the spring or whether it is added in two or three divided doses. The continual annual application results in the same crop for the same total amount of nitrogen added during the year.

Another experiment also clearly shows that it makes no difference whether a soluble manure is buried when applied or left on the surface of the soil.

Many people hold the opinion that the form in which the nitrogen is added as a manure is of importance. Experiments at Tocklai that have now been continued for sixteen years have shown that sulphate of ammonia gives better crops than other forms of manure but is not significantly better than the application of cuttings of *Tephrosia candida* to supply an equal quantity of nitrogen. The cuttings used were green and comprised very little woody material. The average nitrogen content of the undried material as cuttings has been about 1 per cent. and about 2½ per cent. on the dry matter. This material has proved practically as readily available as nitrogen in sulphate of ammonia. Such material evidently needs no further treatment such as composting before application to the soil. These same plots are of interest in showing that the addition of considerable quantities of organic matter annually to the soil over a period of sixteen years has shown no advantage over the continued use of sulphate of ammonia to supply an equal quantity of nitrogen together with superphosphate and muriate of potash over the same period of time.

Another more recent experiment also shows that sulphate of ammonia is the most efficient manure. It is evident then that, so far as crop is concerned, no advantage has been shown for the use of organic manures rather than inorganic.

The tea plucked from these areas has been manufactured in order to find out whether the use of the different forms of nitrogen made any difference to the quality of the tea made. The teas were sent to tasters both in India and London. No significant difference could be found between any of the teas whether made during either the spring or autumn high-quality periods of the year. It seems then that, within the time-limits of the experiment, no difference in quality results from the use of nitrogen in inorganic form as compared with nitrogen supplied as an organic manure. The teas so made have been chemically analysed and it is found that manuring has not significantly affected the caffein nor total soluble solid content of the leaf but that it does make a significant difference to the tannin and to the total nitrogen. Increasing quantities of nitrogen gave increasing percentages of nitrogen in the tea, and decreasing percentages of tannin.

Varying the quantity of nitrogen given as manure has resulted in teas of varying quality. Those teas which received 80 lbs. or more of nitrogen per acre were valued significantly less than teas receiving no nitrogen, though differences were small. The application of 40 lbs. of nitrogen per acre makes no significant difference to the value of the tea as compared with no application of nitrogen.

Experimental data also indicate that some of the organic manures possess a considerably lower efficiency than sulphate of ammonia, for instance sinews and hide, also rape-cake, and it is of interest to note that cattle manure possesses a low efficiency as compared with an application of sulphate of ammonia providing an equal amount of nitrogen.

Generally the tea bushes in North-East India are pruned every year. The amount of the prunings is considerable amounting to 1½ tons of dry matter per acre. The burial of this material has a manurial value but of considerably less efficiency than that of sulphate of ammonia.

It has been generally supposed that the use of a green crop such as cowpeas (*Vigna catjang*) growing amongst the tea during the spring for a short period of about nine weeks, so as to produce the maximum vegetative growth, and then being hoed in, possesses considerable manurial value due to the fixation of nitrogen by the symbiotic bacteria attached to the roots of the leguminous plants.

An experiment conducted over two years has shown that at Tocklai although there is prolific formation of root nodules yet the burial of the green-crop has resulted in neither a loss nor gain to the tea crop as compared with the plot that received no treatment. This result suggests that the growing of the green-crop during a time when soil nitrates are high has resulted in the leguminous crop obtaining its nitrogen from the soil and that no fixation from the air took place.

The growing of shade trees *Albizzia stipulata* amongst the tea is still in a very early stage, but there are indications that the tea under the shade has a bettter cropping value than the tea that is away from the shade.

The work on soil-acidity and liming indicates that :

(1) moderate doses of lime which still leave soil definitely acid have little direct effect on the tea crop. Such doses have been shown to have a beneficial indirect effect—

   (*a*) by allowing good growth of leguminous crops on soils previously too acid for legumes,

   (*b*) by increasing the rate of nitrification of organic manures. This benefit is generally smaller than could be obtained for the same cost by increasing the doses of readily available nitrogenous manure.

(2) small applications of sulphur on soils already acid have little effect. On soils insufficiently acid good results have appeared from the use of sulphur on several estates as well as on the previously heavily limed plots at Tocklai.

(3) lime, whether naturally present or added artificially, in sufficient quantity to render soil about neutral, has a definitely bad effect on the growth of tea.

There are many records of repeated failure to establish tea on soils, naturally non-acid, and we know of no case where tea has been successfully established on such a soil.

Where the lime has been added artificially, it affects the top soil only and tea previously established remains good for some time at least. Yield, however, is reduced and in several such instances deterioration has occurred after some years.

Large quantities of wood ash, such as are added to patches of soil where heaps of timber are burnt during the clearing of heavy jungle, leaves patches unfit for tea. White-ant hills are also non-acid and unfit for tea though they grow leguminous crops well.

The great majority of good tea soils in North-East India have a p_H between 5·0 and 5·5. Very rarely is tea doing well on soils of p_H 6.

The cultivation experiments show that soil stirring, whether deep or shallow, has no good effect and that cultivation is valuable only up to the point at which weeds are suppressed. The general theory then is that the main object of cultivation is to suppress weeds which do harm by slowing down the formation soluble forms of nitrogen in which forms only the plant can take its food. It is a corollary of this theory that cultivation by causing soil nitrogen to be used must exhaust the soil, and plots which in early years yielded poorly through inefficient cultivation retain richer soil and should show greater relative improvement in later years. This is demonstrated in the cultivation experiments at Tocklai which have now been conducted since 1922.

An interesting comparison of the relative value of cultivation is afforded by two treatments. One treatment consisted of giving six rounds of cultivation with a hoe (*kodali, mamooti*) to a depth of 4″ plus forty lbs. of nitrogen per acre as manure in the form of sulphate of ammonia. The other treatment of one round of 4″ depth cultivation with a hoe (*kodali, mamooti*) plus eighty lbs. of nitrogen per acre in the form of sulphate of ammonia. The two treatments have been run as nearly as can be estimated at the same cost. In the early years the plot receiving only one round of hoeing disappeared under tall grass and yielded poorly. Gradually, however, the manuring helped to establish shallow-rooted weeds such as *dhoob* grass and ageratum and produced large growing tea bushes so that at the end of 1934 no weeds were growing under the tea except a few ferns. Treatment with the one round of hoeing and the eighty lbs. of nitrogen has given in 1935 a crop of 16·6 mds. tea per acre, whereas the other treatment, six rounds of hoeing and forty lbs. of nitrogen, has given a crop of 11·4 mds. per acre. A difference of practically 5·2 mds. per acre equivalent to an increase of forty-five per cent. which is greater than can be ascribed to the extra forty lbs. nitrogen and can only be ascribed to the conservation nitrogen in the soil in early years when the soil was infested with bad weeds. It would seem to be equivalent to the leaving of land under grass in an ordinary rotation of British agriculture. This theory of cultivation which we have advocated for a number of years is now receiving support from workers in other countries and on different soils and crop.

The idea that depth is necessary for the cold weather cultivation of tea can be abandoned with safety and economy. On gardens where surface cultivation has been neglected during the busy crop season some form of cold weather cultivation is necessary to clean the land. Any method found efficient and convenient for this object is good.

10. Coffee.

The coffee industry of India is confined to Southern India, comprising the Madras Presidency, Coorg, and the States of Mysore, Travancore and Cochin. The number of reporting plantations in 1933-34 was 6,699 covering a total area of 317,383 acres (of which 3,035 were smaller plantations between 5 and 10 acres covering a total area of 20,260 acres), as against 6,781 plantations with an area of 315,191 acres reported in 1932-33. But the area actually under coffee in the reporting plantations in 1933-34 was 182,851 acres (13,916 acres of these refer to plantations having an area between five and ten acres) as compared with 176,495 acres reported in the preceding year. Of the total area under coffee during 1933-34, Mysore accounted for 55 per cent., Madras and Coorg 22 per cent. each and Cochin and Travancore together one per cent. The total production of cured coffee during 1933-34 was 34·6 million lbs. as compared with 32·5 million lbs. in 1932-33. The average yield per acre of plucked area during 1933-34 was 270 lbs. in Cochin, 246 lbs. in Madras, 235 lbs. in Coorg, 213 lbs. in Travancore and 198 lbs. in Mysore. The figures for 1932-33 for these localities are, respectively, 157 lbs., 166 lbs., 244 lbs., 238 lbs. and 224 lbs. The total quantity exported showed an increase from 173,000 cwts. in 1932-33 to 186,000 cwts. in 1933-34. The value of shipments however fell from Rs. 110 lakhs to Rs. 102 lakhs, mainly due to the depressing effect on prices of the heavy Brazilian crop. In 1934-35 the total export decreased to 141,000 cwts. valued at Rs. 73 lakhs. The principal markets for Indian coffee, as usual, were the United Kingdom and France. The Indian coffee-industry, which has been hit hard in recent years, has had its attention turned to the necessity for propaganda, improvement of marketing and agricultural and technological research, and in furtherance of these objects, planting interests in South India have suggested that a Coffee Cess Act should be passed on the lines of the Indian Cotton Cess Act. The Indian Coffee Cess Act was passed during 1935 and came into force on 1st November that year. For the present the cess is levied at the rate of eight annas per cwt.

As in previous years, work on coffee has been centred at the MYSORE COFFEE EXPERIMENT STATION, BALEHONNUR, and the Coffee Scientific Officer of the United Planters' Association of South India worked in co-operation with the officers of the Mysore Government, investigating chiefly ' Leaf Disease ' and ' Die Back ' in coffee. The monsoon of 1933 was marked by very severe attacks of Die-Back in a great many estates both in Mysore and elsewhere and both sprayed and unsprayed area suffered in consequence. The theory that ' Die Back ' was a consequence of defoliation by ' Leaf Disease ' needed considerable modification in the light of experience in 1933. During this year there was no lack of evidence that the onset of Die-Back was not necessarily preceded by defoliation. The Scientific Officer of the United Planters' Association also continued work on the leaf-count method of studying the relative value of different adhesives and mixtures and the time and strength of the sprays. Two new mixtures were introduced, one employing gingelly oil as an adhesive with Bordeaux and the other, a proprietary colloidal copper spray known as Bouisol. Work on ' Leaf Disease ' during the year was almost entirely concerned with studies of resistance and susceptibility of various families of plants available at the Mysore Station and with the improvement of the inoculation technique.

At Balehonnur work was continued on manuring, spraying and plant breeding. Several kinds of oils including groundnut oil were tested as spreaders and adhesives. As compared with casein, oils were found better and less expensive. Molasses is also being tried and promises to be a good substitute for casein. Light has been thrown on certain obscure points in the life-history of Black Rot fungus of coffee and its control. The study of the shot-hole borer in *Robusta* coffee was taken up and control measures for this and coffee borer are under trial. The results seem to be promising. Experiments were carried out on the biological control of green bug of coffee as large-scale spraying of coffee against leaf-disease proved detrimental to the spread of white fungus which parasitises the green bug. Artificial spread of the fungus was tried and found useful.

11. Rubber.

Rubber is grown mainly in Southern India and Burma. The total area under rubber was 224,178 acres in 1933 and 225,919 acres in 1934. Of 225,919 acres, 175,315 acres were tapped. Of the total area under cultivation, 47 per cent. was in Burma, 43 per cent. in Travancore, 5 per cent. in Madras, 4 per cent. in Cochin and 1 per cent. in Coorg and Mysore. The total production of raw rubber during 1934 was 36,719,521 lbs. as against 12,915,162 lbs. in 1933. The yield per acre of tapped area was 297 lbs. in Coorg, 252 lbs. in Travancore, 224 lbs. in Cochin, 181 lbs. in Madras and 151 lbs. in Burma.

The export of rubber by sea from India to foreign countries rose from 16·2 million lbs. in 1933-34 to 23·6 million lbs. in 1934-35. Of the total exports, the United Kingdom absorbed 47·8 per cent., the Straits Settlements 27·2 per cent., Ceylon 15·6 per cent., Italy 4·1 per cent. and the United States of America 4·6 per cent. of the total exports. The international scheme for the regulation of production and exports of rubber came into operation from 1st June 1934. The export allotment to India for the first control period (June-December 1934) was 3,484 tons for India proper and 2,616 tons for Burma. The average declared value of exports rose from two annas two pies per lb. in 1932-33 to three annas one pie in 1933-34 and to four annas five pies in 1934-35. The Rubber Scientific Department of the United Planters' Association of South India continued to be kept on a care-and-maintenance basis.

12. Fruit.

The period under review marks an era of horticultural awakening in this country. Various provincial agricultural departments, with the financial assistance of the Imperial Council of Agricultural Research in India, have taken up definite fruit research work with a view to extending their fruit cultivation. Indian States such as Hyderabad, Baroda and Mysore are also devoting special attention to fruit research.

In many respects fruit-growing is yet an undeveloped field of work in this country, and its development may lead to substantial monetary benefits to the growers. The Indian public are being educated to the high dietetic values of fruit, with the result that the demand is daily increasing. The fact that the prices of Indian fruits have been comparatively less affected by the world-wide agricultural and economic depression, has encouraged an increase in the area planted to fruit trees. It is noticed that the acreage under fruit crops in the Punjab and the Bombay Presidency has increased considerably in recent years.

The Imperial Council of Agricultural Research, realising the future of this industry, has liberally contributed towards the expenditure now being incurred on fruit investigations in various parts of India. During the last two years the Council has allotted Rs. 54,370 for cold-storage research work and Rs. 5,545 for the experimental export of mango to Europe from the Presidency of Bombay; Rs. 2,500 for the preservation of fruit and vegetables and Rs. 7,020 for research on citrus 'wither tip' in the Punjab; Rs. 25,328 for a hill fruit research scheme in the United Provinces; Rs. 15,030 for fruit research work in Bihar and Orissa and Rs. 29,000 for establishing a fruit research station in Bengal. Several other schemes forming part of a co-ordinated whole will receive grants during 1936, *viz.*,

	Rs.
(i) Assam fruit-cultivation scheme	37,000
(ii) Central Provinces Orange Scheme	71,000
(iii) Punjab Citrus stock grape vines scheme	58,000
(iv) North-West Frontier Province fruit-cultivation and fruit marketing scheme	27,000
	1,93,000

The researches on fruit-crops in India are intended to tackle problems of increase in the yield of crops, of extension and methods of planting, of application of manures, of preserving fruit by cold storage or by canning, of evolving new strains and comparing the merits of existing ones. Improvement in the system of marketing and handling of produce by co-operative methods is also receiving the attention.

BOMBAY. The strains of guava selected at the Ganeshkhind Fruit Experiment Station are superior to the local varieties. Out of them, Lucknow Guava 49 and 43 are now being planted out on a small scale by the growers. At the Modibag Gardens, Poona, success has been achieved in evolving a new type of grape vine which gives superior fruit as compared with the local Bhokari variety. This strain is now under trial. New introductions of fruits, *viz.* the Italian and Eureka lemons, the Washington Navel orange, and the grape-fruit, are also being tried with a fair promise of becoming popular. The stoneless *bor* is still another interesting type of fruit, the extensive cultivation of which may be possible in some parts of the country.

In the UNITED PROVINCES, the selection and multiplication of higher-yielding strains of straw-berries, guava, mango and loquat are in hand. The Hill Fruit Scheme in the United Provinces has given rise to fruit research station at Chaubatia, where researches relating to the improvement of fruit cultivation in all its aspects are being carried out. The United Provinces Government have lately appointed a Fruit Expert to give plantation advice and to organise the growers in their province. The Bihar and Orissa Government have established a fruit station at Sabour for the improvement of plains fruit.

In the PUNJAB the selection of grape vines and malta oranges is the chief work in hand. In MADRAS, work evolving new types of banana and coconut by hybridisation is already undertaken.

Researches relating to propagation and cultural practices have not made much headway during the period under review, evidently owing to the slow nature of the work involved. The budding of mango has achieved success to the extent of about 20 per cent. at Poona, when the operation is done in August and September. The grafting of citrus has yielded better results than budding at Coonoor in MADRAS. The ringing of Sangtras, Maltas and grapes was successfully carried out in the PUNJAB with increase in the yield of crop. Investigations were undertaken on the periodicity of bearing of mangoes in Bombay and in BIHAR AND ORISSA, and the only significant information which has yet been recorded on this question is that the spur requires 8 to 10 months to mature before producing blossom. Arresting the vegetative growth of mango trees in the off-season is now under investigation. The Imperial Council of Agricultural Research has deputed a physiologist for research work at the East Malling Fruit Research Station on the problem of alternate year-bearing of fruit-trees. On his return he will take up the problem of mangoes. The question of finding out better stocks for citrus, mango and apples has been in the fore-front for several years past. Experiments relating to this problem are being carried on at Modibag, POONA, and at Chaubatia in the UNITED PROVINCES. The results obtained up-to-date are promising, but it is too early to draw any conclusions. The manurial trials conducted on banana at POONA and at COONOOR show that with extra manures comparatively well developed bunches with a larger number of fruits can be obtained. Similar work on peaches is now being done at Chaubatia in the UNITED PROVINCES. The PUNJAB Department of Agriculture has also conducted extensive manurial experiments on citrus. The results so far obtained go to show that bone-meal and sulphate of ammonia in conjunction with farmyard manure give the highest yields. The manurial trials on banana have given valuable results at Samalkota in MADRAS, where it is observed that an application of potash or ashes increases the keeping quality of plantains by two or three days. It is also observed that the crop which received a complete manure matured earlier than the one with deficient manuring.

The improvement of the system of marketing has also received some attention. In BOMBAY a report on 'Improvement in the Marketing of Fruit and Vegetables in the Town of Bombay' has been lately compiled by a Committee appointed under the authority of the Government to investigate the problems of marketing fruit and vegetables in this town. It throws light on the defective and primitive system which exists in our premier markets to-day.

Marketing of the Nagpur oranges in the Central Provinces has also been studied. Similar studies are being undertaken in other provinces also. The Central Marketing Staff, appointed in 1935, has undertaken with the help of the Provincial Agricultural Marketing staff, marketing surveys on the principal Indian fruits. The Madras Municipal Corporation have given a lead to the country by opening an up-to-date fruit market at a cost of rupees two lakhs in their city.

Fruit-growers have been organised into associations and boards in Bombay, the United Provinces and the Punjab, in order to surmount their common difficulties and handicaps as well as to safeguard the larger interests of the fruit trade. As a result of over a decade of unremitting effort in the Bombay Presidency, the real interest of the growers in marketing their produce has been stimulated. The chief railways have temporarily announced concessions in freight charges on some perishable fruit and vegetables from their growing centres to the Bombay markets. Pine-apples are now carried at a concession rate by railways from Bihar to Calcutta. Rapid means of transporting these products are being adopted more generally than before. The benefit of these improvements is increasingly reaped by the growers, who are now making co-operative effort to retain facilities which they have got.

The question of the preservation of surplus fruit has also come into prominence during the last two years. The Imperial Council of Agricultural Research has given a grant-in-aid for the investigations relating to the utilisation of the surplus fruit and vegetables in the Punjab. Investigators in that Province have worked out the possibilities of preparing tomato pulp as a commercial product in India. They report that tomato ketchup and other tomato products can be bottled on a commercial basis with a considerable margin of profit. Preparation of grape juice, and lemon and orange squashes are also giving encouraging results in the Punjab. Some research pertaining to the bottling of fruit juices is being conducted at the Indian Institute of Science, Bangalore. The manufacture of guava jelly and bottling of lime juice are now successfully demonstrated at Poona. Research in the preparation of plantain-figs is done at Aduturai. This preparation is favourably received by the trade. The Chakrakeli variety of banana is found suited for it. The curing of dates has also progressed to some extent in the Punjab. A large number of other Indian made fruit products have been put on the market during the last two years.

The cold storage investigations were originally restricted to finding out the optimum conditions for commercial storage of mangoes. The Imperial Council of Agricultural Research established an experimental cold storage plant at Poona in 1934 for this purpose. The work is now extended to oranges, bananas, papayas, peaches and potatoes. The conclusions so far reached show that the Alphonso mango can be preserved for nine weeks at 45°F. and that the Nagpur orange (Santra) can be stored at 40°F. for about three months.

Some work was also done during the period under review to combat the pests and diseases of fruit trees. The application of sulphur dust to mango blossom against Jassids and Powdery Mildew is found successful in the Bombay Presidency. This remedy increases the cost of production but brings an increased return of Rs. 7 to Rs. 8 per tree. A campaign against the San José Scale has been undertaken in the Punjab and Kashmir. The United Provinces Department of Agriculture is tackling the apple root-borer (*Lophosternus hugeli*), the woolly aphis and several insect pests.

13. Fodder Crops and Grasses.

The Imperial Institute of Agricultural Research, PUSA, continued work on the improvement and introduction of fodder crops. Kudzu vine (*Peuraria thunbergiana*) is one of the latest and most promising leguminous crops introduced to the notice of the farming world. It is a native of Japan, where the vine is used for pasturage and hay-making. It is a very promising, perennial legume. In small-scale trials, carried out to find its fodder value, it has been found to yield about 30 tons per acre of green stuff on good cultivated lands, and 18 tons per acre on poor lands. It gives 3-4 cuts during the year. These yields compare favourably with those obtained in U. S. A. The analysis of Kudzu vine showed that it has a high feeding value like lucerne, cowpea and velvet beans. It contains 0·4 to 0·5 per cent. nitrogen.

As berseem (*Trifolium alexandrinum*) plays an important part in the milch-cattle feeding programme, it became necessary to find some means of continuing to feed it beyond its ordinary growing period of December to May. It was turned into hay for summer feeding, but hay was difficult to handle, as it was extremely brittle. To overcome the above difficulty, 950 maunds of green berseem was buried in two *kacha* silo pits to test the class of silage and its palatability and food value. Silos were opened in May after a lapse of three months. The silage taken out was of good colour and possessed a pleasant smell. Cattle ate it greedily. 616 mds. 28 srs. or 65 per cent. silage was obtained, but this was very watery and difficult to handle, so in other experiments oats and berseem mixed in varying proportions were ensiled. The silage obtained from these mixtures was of excellent quality, and possessed sweet smell. It formed a satisfactory substitute for green berseem throughout the dry period, when it was not available. In this way it was possible to maintain the stock at Pusa throughout the year either on green berseem, berseem hay, or berseem silage, and there was no need for other green fodder crops to be grown.

The testing of oats varieties, evolved at Pusa, was continued. Hybrid C and J gave good results.

PUNJAB. As a result of studies on *juar* (*Andropogon Sorghum*) two promising selections, *i.e.*, J S Nos. 20 and 21 were separated. Experiments conducted at different centres have shown conclusively that the selection of sweet *juar*, known as J S 21, is outstanding in its yield and other qualities as a fodder crop. Besides being high yielding and disease-resistant, it is sweet. As high-yielding sweet *juars* are in great demand with the zamindars, the seed of this selection is being multiplied for distribution.

Of all the newly introduced fodder crops, Sudan grass (*Andropogon Sorghum* var. *Sudanensis*) has spread most quickly in the province. At present the limiting factor in its widespread cultivation is the scarcity of seed. Arrangements are, therefore, being carried out to multiply its seed on a large scale.

Fo S 1, a selection of cowpeas (*Vigna catiang*), was recommended for cultivation in 1932. This crop fills the gap in the supply of green fodder for the scarcity period of May and June. It has been spreading rapidly, as is shown by the keen demand for its seed. Its quick popularity is due to its high nutritive value, and its ability to mature quickly and to enrich the soil where it grows.

Guara (*Cyamopsis psoraloides*) is an important fodder crop both for irrigated and *barani* tracts. It is cultivated both alone and in mixture with *juar*. Work on its improvement was carried out and a selection, namely, Fo S II was isolated and tested against the local. The selection has been found to be decidedly superior and yields fifteen to twenty per cent. higher than the local have been obtained.

Velvet-beans (*Stizolobium deeringianum*), soy-beans (*Glycine hispida*) and teosinte (*Euchloena mexicana*) are promising fodder crops especially for bridging the scarcity gap, occurring in October and November. Teosinte mixture with the other two gave very heavy yields of green fodder.

Meth (*Phaseolus aconitifolius*) is an important crop in *barani* and irrigated areas and work on this has been started and a few promising selections are reported to be in hand. In a test carried out, 8 A meth has given very high yields of green fodder. At Sirsa Botanical Sub-station, it yielded 324 maunds of green fodder per acre. Trials and further selection will be continued.

Elephant grass (*Pennisetum purpureum*), Guinea grass (*Panicum maximum*) and Rhodes grass (*Chloris gayana*) are perennial high-yielding fodders capable of giving 5-6 cuts during the year. Cultivation of Elephant grass is extending in the province, while the other two appear quite promising.

Among the pasture-grasses, *anjan* (*Pennisetum cenchroides*) has been noted to be the best under cultivated and dry farming conditions. This grass is highly nutritious and dominates the south-eastern part, which is the premier cattle-breeding tract of the Punjab. Selection work on this grass yielded four varieties varying in colour of spikelet, *i.e.*, white and purple (*Pennisetum cenchroides*); white and purple (*Cenchrus biflorus*). Out of these white

(*Pennisetum cenchroides*) was multiplied and tried at different places. It did very well. Trials on an extensive scale will be carried out.

Rabi fodders. Berseem (*Trifolium alexandrinum*) has thoroughly established itself, and its cultivation has been taken up throughout the province. There is a very large demand for its seed and for bacterial cultures for inoculation purposes.

The Punjab Department of Agriculture has made interesting experiments on 'How to raise good seed of berseem'. In connection with the production of pure seed of high percentage of germination capacity, some precautions are necessary. For purposes of fodder, 5-6 cuttings are taken from a crop in the season. From the table given below it will appear, however, that the best seed is obtained from a crop from which no cutting is taken:

Sample	Percentage germination	Weight of 500 grains	Yellow seeds	Brown seeds	Black seeds
No cutting	91	18·47	..	..	..
One cutting	82	12·56	..	..	..
Two cuttings	61	12·43	..	..	..
Three cuttings	29	11·88	..	..	..
AVERAGE PERCENTAGE GERMINATION.	..	..	88	44	26

It has been further observed by the study of the colour of the seed in samples of berseem that it consists of seeds of three colours—yellow, brown and black. The percentage of germination of these three kinds of seeds has shown considerable variability. When purchasing seed, preference should be given to that in which yellow coloured seeds predominate.

Seed of berseem is generally mixed with seeds of a large number of weeds. As many as thirty weeds have actually been sorted out from a field of berseem at Lyallpur; of these wild plants *Chichorium intybus* (Kashni) is generally present in large quantities and is most undesirable.

French oats (*Avena sativa*), Algerian oats (*Avena sterilis*) and a selection made by the Fodder Specialist (*Avena sterilis*) were tried at various farms in the province. From the results of two years' experiments, it appears that each variety suits a particular locality. All these varieties have good qualities and can be recommended. In addition to these, a large number of selections and varieties of oats are under observation. Some appear promising and are being tried to get conclusive results regarding their fodder and grain yield. Cross-breeding between good varieties is in progress.

A promising selection of *senji* (*Melilotus parviflora*) has been separated, while the studies on *meth* (*Trigonella foenum-groecum*) crop have resulted in the evolution of half a dozen better strains.

Japan white-leaved rape (*Brassica compestris* var *Rapa*) has consistently outyielded all other kind of rapes and is now being recommended for cultivation.

Trials with Bhabbar grass (*Ischaemum angutifolium*) were concluded and it was ascertained that it could be cultivated successfully in the plains, if good planting material was available in the form of rootstocks, but as a good deal of labour is required to maintain the plantation, it is not advisable to recommend its cultivation.

Experiments were also laid out with soil-binding plants in the eroded forest areas in the Kangra District.

BOMBAY. The experiment on rotational grazing at Mangdara Kuran near Diva Ghat, Poona, was continued by the Economic Botanist to Government, Bombay, Poona, with the addition of land development work and the study of invasion of spear grass (*Andropogon contortus*). 250 animals were put to graze from 14th August 1933 to the end of February 1934. The interval between two shifts from one block to another varied with the feed available; in the beginning it was 15-20 days, and gradually fell to 5 days as the season advanced and vegetation showed signs of drying up.

SIND. Sunflower (*Helianthus annuus*) single-head variety has given good results as it gives good seed. The crop has possibilities for fodder production, as it can be grown throughout the year. Berseem has been grown on all the Government farms, and it has been found on Mirpur Khas farm, that it not only gives an ample supply of nutritious green fodder, but also contributes largely to the maintenance of soil-fertility and the reclamation of alkali patches. Three fodder *juars*, Acho Kartuho Turi 56, Red Turi and Achi Turi have maintained their character of high yield of green fodder and are being grown for seed multiplication on Government farms. Cowpea is also cultivated as an alternative food and fodder crop for the Barrage areas. It is useful as a green manure crop on account of its vigorous vegetative growth.

Punjab oats supply high yields of green fodder and are sown from October to end of November, while Russian rye can be sown as late as end of December and remain green until the end of April. *Melilotus parviflora* was tested and found to grow luxuriantly.

MADRAS. A study on indigenous fodder grasses was continued at the Central Farm, Coimbatore. Comparative trials of *cholam* and *cumbu* as fodder crops, show that *cumbu* gives nearly double the yield. Work on selection of suitable fodder *cholam* strains was in progress in Nandyal and Koilpatti. At the former station some of the selections yielded better than the standard. Teosinte (*Euchloena mexicana*) which was grown on field-scale at the Livestock Research Station, Hosur, grew about ten feet tall with profuse tillering and yielded good fodder and hay. At Coimbatore the following yields per acre were obtained:

Elephant grass 53,836 lbs., Guinea grass 39,493 lbs., teosinte 37,530 lbs., lucerne 25,186 lbs., maize 19,383 lbs. and *cholam* 22,463 lbs.

A survey of Malabar pastures has been made by the Chemist, while digestibility trials on fodder are also in progress.

Pillipesara, another fodder crop, which has been introduced in all parts of the Presidency was grown mixed with Teosinte at the Aduturai Agricultural Research Station. After the harvest of teosinte, *pillipesara* did very well and gave an acre yield of nearly 11,000 lbs. in a single cutting.

Kikuyu grass is under experimental cultivation at the Potato Research Station, Nandanad. To get over the difficulty of fodder-scarcity during summer, ensilaging of hill grass which grows abundantly during monsoons has been successfully carried out at the Agricultural Research Station, Pattambi.

BENGAL. The Second Economic Botanist continued work on the improvement of fodder, *e.g.*, *juar*, maize, cowpeas and fodder grasses. Cowpeas, which proved successful under cold weather-conditions, were multiplied for distribution among the cultivators. Of these, " Groit " and " Whip-poor-will " have proved the highest yielders, but none of these stand up to excessive cold.

There has been a very heavy demand for the cuttings of Napier grass (*Pennisetum purpureum*) which it has been found difficult to meet. This crop gives a very high yield of 1,000 maunds per acre under non-irrigated conditions. Under irrigation and heavy manuring, yields of over 2,000 maunds per acre have been obtained.

UNITED PROVINCES. A better fodder supply, which is necessary for raising the inherent qualities of drought and milch animals, is receiving due attention at the hands of the cattle-breeding staff in trials with perennial fodder and in the conservation of annual growths by silage.

BIHAR AND ORISSA. A good deal of attention is paid to the cultivation of fodder crops at all the farms. Berseem (*Trifolium alexandrinum*) has now an assured place in the cropping programme of each farm where irrigation is available and milch animals are maintained. Napier grass has also established itself in the farming practice. It grows without much care or trouble and occupies odd bits of lands and yields very welcome green fodder. Silo-ing of crops like maize and *juar* is practised extensively on all farms both for feeding the farm animals and for demonstration purposes. At the Kanke farm growing of lucerne on large scale has also been taken up. In addition to these leguminous fodders such as cowpeas, *meth* (*Phaseolus aconitifolius*), *mashyam* and soy-bean (*Glycine hispida*) are grown to provide a succession of green fodders from August till the end of November. The result is that the dairy herd is provided with the very best leguminous fodders available, from November to June.

ASSAM. Fodder crops are grown in the cultivated fields in rotation with potatoes. The main fodder supply is grass which grows in the valleys and spare uncultivated hillocks. The main fodder crops are maize, *raishan* (*Khasi* millet), cowpeas, soy-beans and the mixed grass (*Paspalum dilatatum*) and Kikyu grass were also tried. Good hay was made from the former, while the latter gave a good crop when planted under the pine trees sparsely growing. The cost of producing green grass was Re. 0-2-10 per maund as compared to green maize at Re. 0-7-10 per maund.

TRAVANCORE. Guinea grass at the Trivandrum farm was affected by prolonged drought and yielded much below normal. On irrigated areas it gave 18,000 lbs. as compared to 8,500 lbs. per acre on non-irrigated areas, but is finding favour with the ryots. Napier grass has proved sturdier, but is less relished than Guinea grass. Its cultivation is also increasing steadily. *Papsalum larrangai*, another drought-resistant grass, is also under trial. Shevri (*Sesbania Egyptica*) continued to do well under irrigation and yielded good supply of green material at intervals of 20-25 days, which was eaten by milch cattle with avidity. Teosinte and soy-bean have also been found to yield good supplies of green stuff.

14. Millets.

The principal millets cultivated in India are *juar* (*Andropogon Sorghum*), *bajra* (*Pennisetum typhoideum*), and *ragi* (*Eleusine coracana*), and they occupy together an area of about fifty-seven million acres. Of these *juar* is by far the most important, occupying as it does about 33·48 million acres. *Bajra* comes next with 16·4 million acres and then *ragi* with nearly seven million acres. Other millets such as *kangni* (*Setaria italica*), *kodo* (*Paspalum scrobiculatum*), and the *Panicums* are of more local importance. In two provinces, Madras and the Punjab, Millets Specialists are in charge of the work of improvement of these crops.

Juar (*Andropogon Sorghum*). The chief *juar*-growing areas, in order of importance, lie in Hyderabad, Bombay, Madras, the Central Provinces, Rajputana and Gwalior States and the Punjab. *Juar* is also an important fodder crop, especially in cattle-breeding centres and near towns.

HYDERABAD has about twenty-five per cent. of the total *juar* area in India. Work on *juar* is carried out at the Experimental Farm, Parbhani, and selection is in progress both in *kharif* and *rabi* crops. Of the *kharif* varieties one local variety, Nanded Yellow, proved to be resistant to diseases and insect pests and two imported varieties Ramkhel and Saoner gave the highest yields. In the Karnatak division, the Dagdi variety of *juar* was introduced and the results have been favourable. Treatment of seed with sulphur powder to prevent smut, instead of the copper sulphate treatment, was recommended and demonstrated.

BOMBAY has about twenty-three per cent. of the total area under *juar*. At Surat Budh Perio 53 yielded significantly better than Bardoli local selection; 18,000 lbs. of pure seed of Budh Perio 53 was distributed in Surat district. The work of isolation of desirable strains in Aispuri variety of *juar* suitable for Khandesh conditions was continued on the Jalgaon Farm. In Khandesh, the Maldandi variety of *rabi juar* is steadily spreading in the trans-Tapti tract. The use of graded seed of *juar* mixed with sulphur dust, sowing with improved seed-drill in plots with low bunds to check surface erosion, and constant intercultivations, are the important operations to ensure success in dry farming. During the year 1933-34 the comparative trials of dry farming *versus* local method were made in the Deccan and results were decidedly in favour of the former. In all trials very much higher yields of grain were obtained by the dry-farming methods. But dry-farming experiments conducted at Bijapur have confirmed the inferences of last year (1932-33) that the value of the extra yields obtained by following the dry-farming methods does not cover the cost of extra operations and they do not, therefore, stand the economic test with local method. The need for further endeavours in this direction is indicated. The practice of mixing sulphur dust with *juar* seed before sowing as a preventive against smut was advocated. In the Deccan districts alone 11,106 packets of sulphur were distributed. Breeding, cultural and manurial experiments were in progress at Mohol. Yield-trials of locally important varieties were conducted at Dharwar, Surat, Broach and Viramgam.

In MADRAS, where the area under *juar* is about five million acres, the improved strains already introduced in the Deccan tract (Ceded Districts) are Tella Jonna (*S. cernuum*—White sorghum) type T 1 and Patcha Jonna (Yellow sorghum) type T 6. It is estimated that T 6 occupied an area of about 20,800 acres in 1934-35. At Nandyal Farm strain N 28/3 has given consistently higher yields than T 6 during the last three seasons. At the Millets Breeding Station, Coimbatore, about 800 selections were handled for economic and scientific studies. Of the new strains tested, two irrigated white-grained selections of a short duration, A S 2095 and A S 3023, proved superior to the standard strain A S 367. A new irrigated yellow-grained strain A S 1195 yielded better than the existing strain A S 809. At Koilpatti, the Coimbatore strains A S 367, A S 1059, A S 2095 and A S 3023 were all superior to the local seed. Of these, A S 2095 gave an increase of about thirty-five per cent. A S 367 has done well in the Chittoor, North Arcot and Trichinopoly districts also. A S 1575, another irrigated white-grained strain of medium duration, is spreading in the Coimbatore and Salem districts. A S 29, the dry-land yellow-grained strain for the Coimbatore district, has yielded thirty-four per cent. more than the local seed in trials in ryots' lands. Varietal, cultural and manurial experiments were in progress at Hagari, Nandyal, Guntur and Koilpatti Agricultural Research Stations. Intensive botanical and genetical studies are in progress at the Millets Breeding Station at Coimbatore.

In the CENTRAL PROVINCES, two new strains E B 1 and 123 A were distributed and uniformly satisfactory reports concerning these were received. At Akola farm these strains yielded 2,074 and 2,124 lbs. of grain respectively. Seventy-eight different strains of *juar* were sown in single-line culture and the six best were grown in bulk for comparative tests.

In the PUNJAB, the *juars* have been classified and 149 types have been isolated. The immediate economic value of the classification of these *juars* has been the discovery of types-numbers 651, 893 and 908, which have now been tested for three years and found promising both as regards grain and fodder. The department's best selection is J 8. It has outyielded the local seed in every place where it has been tested.

Bajra (*Pennisetum typhoideum*). The total area reported under *bajra* is about 16·4 million acres. The chief *bajra*-growing Provinces are Bombay, the Punjab, Madras, the United Provinces and the Hyderabad State. In BOMBAY, Akola *bajra* continued to give heavier yields than local varieties in trials and about 23,000 lbs. of seed was distributed (1933-34) in the North and South Central divisions. As with *juar*, seed-grading was tried and graded seed gave on an average four per cent. more yield, the cost of grading being negligible. At Poona, the comparison of a mixture of strains with individual strains is in progress. At Karjat, Niphad local and Akola *bajra* gave significantly higher yields than Poona strains. The botanical study of *bajra* varieties is in progress at Karjat. In the PUNJAB improvement of *bajra* by selection was continued. Two selections A 1/3 and 61/21 have established beyond doubt their superiority over local mixtures. In MADRAS, M S P T 2229, a selection from the variety Kottapuli *cambu*, has proved the best in comparative trials. Good selections from the long-headed variety named Punjab *cambu* have been multiplied and are much in demand from the cultivators. In HYDERABAD, in the west Telingana Division, a Cawnpore bristled variety was introduced and is popular with the cultivators, as the bristles protect the ear-heads from untimely rain at flowering time and the grain from bird damage.

Ragi (*Eleusine coracana*) is grown in an area of about seven million acres of which the Mysore State and Madras have one-third each, and most of the rest being in Bombay, Bihar and Orissa, and the Hyderabad State. As *ragi* is the most important single crop in MYSORE, much attention is devoted to it. Strain H 22 has become exceedingly popular on account of its drought-resisting and high-yielding qualities. The trial of three new strains H 55, H 56, and H 45 was continued along with the established strain H 22, and they were multiplied for supply to the agricultural farms. In the Kar ragi Breeding Station at Hunsur, a large number of selections were tested and six of them have been found very promising. Work is under way to select an early type with compact ear-heads for this tract. In MADRAS, strain E C 593, evolved at the Millets Breeding Station, Coimbatore, continued to be the best strain. It is reported to have done well in Chittoor, Coimbatore, Salem and Trichinopoly districts, as well as in the Deccan area. *Ragi* strains 525 and 355 evolved at Anakapalli are popular in the Circars. On an average, they gave 14·8 to 13·3 per cent. more yield than local *ragi*. An intensive botanical study of the plant is in progress at the Millets Breeding Station, Coimbatore. In BOMBAY, improved strains B II (early), E 31 (intermediate) and A 16 (late) are being popularised in the Konkan district. B II gave twenty-five per cent. more than local in the Satara district (1933-34). Selection work is carried on in the Kanke Farm in BIHAR and ORISSA.

Other millets. Of the other millets, *Setaria italica*, the Italian millet (*kangni*) is the most important. At Coimbatore a strain S I 523 has proved to be promising and seed is being distributed. Selections from *Kodo* millet and other minor millets (*Panicums*) are under study.

15. Other Cereals.

Maize is grown in about seven million acres of which about two-thirds are in the United Provinces. Selection work is in progress. Being a normally cross-fertilised crop, special precautions are necessary to maintain a strain pure. In the PUNJAB, natural cross-pollination in maize in experimental plots was minimised by growing two types of maize separated from each other by a belt of sixteen feet of Elephant grass. In BIHAR AND ORISSA, in trials between Pusa 3 and Jaunpur maize, there was no significant difference. At the Kanke farm in South-East Bihar local maize gave a higher yield than Jaunpur White. In the North-west Frontier Province, Iowa Silvermine, introduced in 1933-34, yielded better than Peshawar White in the Kurram Valley. The seeds of the new variety were distributed. In Bannu and Tochi Agency of North-west Frontier Province, Swabi White proved better than local and Silvermine. The latter was a late variety and did not find favour with the zamindars.

Barley is one of the staple crops of Northern India and occupies about seven per cent. of the total area (seven million acres) under this crop. Type 21 barley, isolated at Pusa in 1926, is increasing in popularity and maintaining its reputation for heavy yields, and plump and well-filled grain. It has been reported to be successful at Cawnpore, Shahjahanpur, Etawah and Raya in the United Provinces, at Dholi, Sepaya, Sewan, Sabour and Muzaffarpur in Bihar and Orissa and at Mewar in Rajputana. The straw is strong and the variety is therefore not very liable to lodge. The presence of a purple tinge on the seed-coat limits its usefulness for malting and brewing purposes as this colour imparts an undesirable dark tint to the beer. Attempts are in progress at Pusa to breed out this colour, whilst retaining the favourable qualities of Type 21 by hybridising it with a number of other barleys. In addition to the economic work, the genetical study of this cereal forms an important item of work of the Botanical Section at Pusa.

In the UNITED PROVINCES, barley C 251, which has been shown to be very valuable malting barley for export, is being multiplied rapidly for wider issue, while a search for even better types continues.

In Bihar and Orissa, a survey of the Bihar barleys was in progress. Twenty-two samples of Bihar barley were grown for selection work, and 20 five-pound samples were got ready (1933-34) for despatch to England for a test of malting and brewing qualities.

In the PUNJAB, arrangements are under way to obtain a final large-scale test as to the best variety from the malting and brewing aspects. Experiments have shown that types 4 and 5 gave the best yields; and these are being supplied to cultivators. Type 4 is also good for the manufacture of ' Pearl ' and ' Powder ' barley products. Work on cross-breeding is also in progress.

Oats. Though of minor importance in India, oats are valuable as a fodder crop and large areas are devoted to its cultivation near towns, particularly near military stations. Two types B S 1 and B S 2, isolated at Pusa, are now known for high yield and resistance to drought. The grain in these is not so plump and the straw not so abundant as in many European oats. The latter, however, require much too long a growing period to be suitable for Indian conditions. With the object of uniting the good grain quality of exotic oats with the shorter duration and agronomic qualities of Indian oats, a number of crosses have been made and some very promising hybrids obtained.

Among different varieties of oats tried at the Patna farm in Bihar, B S 1 has given the highest yield in 1933-34. At Sepaya, Sewan and Byreah farms, Pusa I and Sepaya local were again very significantly better than Pusa hybrid C and hybrid J.

In the Punjab, oats continued to receive considerable attention. The Algerian selections and Fos 1/29 appeared to be even superior to French varieties both in quality of fodder and in drought-resistance. They gave higher yields than the French oats under *barani* conditions. Oats are gaining in popularity in the Province as improved varieties are being brought to the notice of the zamindars.

Four varieties of oats from Pusa were tried at the Irwin Canal Farm in Mysore, and of these B S 2 and hybrid J did well. There seems to be a bright prospect for the cultivation of oats in Mysore.

16. Potatoes.

The comprehensive scheme of research and breeding work on potatoes with the aid of a grant from the Imperial Council of Agricultural Research referred in the last year's review was carried out during the period at the Madras Agricultural Department's special potato farm at Nanjanad in the Nilgiris (elevation 6,500 ft.) for South India and by the Botanical Section of the Agricultural Research Institute at Pusa and in the summer of 1935 at a substation at Simla.

At PUSA, the collection and study of material from different parts of India and from abroad was undertaken. A valuable collection of South American species of *Solanum* has been built up with the aid of the Imperial Bureau of Plant Genetics, and research workers in the United States of America and U. S. S. R. Arrangements were made for preliminary investigations in the hill during the summer of 1935. In order to ascertain the best site for a potato-breeding station in the hills, co-operative experiments were in at the following hill stations :—

United Provinces :—Chaubattia and Ramgarh.
Punjab :—Kulu Valley and Murree Hills.
Assam :—Shillong.

Work was also carried out at Simla in the grounds of the Rust Research Laboratory.

Experiments on the yields of potatoes grown from tubers stored with and without charcoal at Pusa showed that out of the thirty-two pairs of plots compared, in twenty-five plots the yield was higher from tubers stored with charcoal and the average yield of thirty-two plots was 14·9 per cent. higher from the tubers which were stored with charcoal than from the tubers stored without charcoal. The potatoes stored in charcoal at Pusa were in almost all cases about ninety-six per cent. sound and had lost about twenty-five per cent. moisture only during storage, showing that the method eminently served the purpose of storing the tubers till planting. The object of breeding work at NANJANAD is to produce new varieties of potatoes suitable for various parts of India, by the raising and testing of seedlings and the production of hybrids as well as by the acclimatisation and testing of improved varieties. During 1933-34 twenty new varieties were tried among which four were found promising, *viz.*, Bishop, Gharwal, Khabrar and Windsor Castle. Ben Cruachan, Great Scot and Royal Kidney, three of the earlier selected varieties, were being largely grown by the ryots of the district, Great Scot being most popular.

The results of manurial experiments showed that potash not only increased the yield but also gave resistance against 'early blight'. Municipal compost-manures were found equal to cattle-manure. Shallow ridging gave twenty per cent. more yield than deep ridging in addition to being more economical. Experiments on the size of tuber and spacing showed that 1½ oz. tubers at nine inches apart were the most economical for this crop. The work of hybridisation, which was beset with difficulties in this crop, received some measure of success during 1934-35. Out of 2,164 flowers, which were artificially pollinated, 631 seedlings were obtained, but only sixteen survived. Twenty-one varieties were under row-yield trials and ten under comparative trials, including both early and late types.

Nine hundred and eighty maunds of potato seed, mostly Great Scot, were issued for seed-farm sowings in the Nilgiris. In addition 64,694 lb. were sold to ryots. Great Scot, Royal Kidney and Ben Cruachen were distributed in certain taluks of Salem district and they were reported to have done well.

Further experiments carried out in the UNITED PROVINCES conclusively proved that tubers for planting from the colder hill-regions gave a far better crop than those from seeds stored in the plains through the summer. In course of this work it was found that the seed-potatoes required rest period of nearly three months before they sprouted and were ready for planting. Hence the hill seeds must be from the early crop harvested in July before the rains. Those from the main hill crop raised in September-October could not be used for planting in the plains in October.

Comparative trials in replicated plots carried out in five Government Farms in the United Provinces had statistically proved that one of the present hill varieties was superior in quality and money return to the potatoes of the plains, and one of the English varieties imported for trial a few years ago was superior to this hill-variety. Extension of this English variety in the hills was taken in hand. In the meantime a few Scotch varieties imported through the Department of Agriculture of Scotland were under trial and by the time the English variety had established itself in the hills so that large quantity of its seeds from the early crop were available for export to the plains, one of the Scotch varieties proved better than the English one in every respect. Thus an organisation was started for supplying seeds of improved imported varieties one after the other from the hills to replace the virus-infected and poor local varieties of the plains.

In collaboration with the Imperial Council of Agricultural Research, preliminary trials of the available varieties were carried out during the summer of 1935 at Chaubattia, Ramgarh (U. P.), the Kulu Valley, Murree Hills and Kotgarh (Punjab), Shillong (Assam) and Simla. Observations were made at these trials to ascertain at what station potatoes would fruit and produce viable seeds with the greatest certainty.

PUNJAB. The potato work, which had been carried on in the Simla hills for over twenty years, was shifted to the Kangra valley. The Punjab imports seed-potatoes worth about Rs. four lakhs, annually. Owing to the heavy losses which occurred when potatoes were stored in the plains during the hot summer months, seed for the autumn-grown crop had usually to be imported at high cost from outside the Punjab. Kangra valley was selected in order to determine the possibilities of rendering the Punjab self-sufficient in the supply of seed of suitable varieties for the crop in the plains. Results of investigation so far obtained showed that the crop harvested in the Kangra valley in the spring could be stored during the summer without undue loss and would provide a suitable and comparatively cheap source of seed-supply for the autumn-sown crop in the plains. Experiments having a similar object were being conducted in the Salt Range.

In collaboration with the Imperial Council of Agricultural Research, the Department carried out experiments on a small scale in the Kulu valley and the Murree Hills to determine the suitability of these centres for potato-breeding purposes.

ASSAM. The work on potatoes at the Upper Shillong Farm consisted of variety trials, experiments to discover types resistant to *Phytopthora infestans*, manurial experiments and growing potatoes for seed.

During 1934-35 fourteen varieties were under trial in 1/200th acre plots replicated four times. Yields were higher even than in former years, the highest being of from Arran Banner imported in 1933 and Up-to-Date imported in 1930.

Experiments with chemical fertilizers during 1933-34 showed that ammophos with potash gave the best results followed by ammophos alone. During 1934-35 manurial experiments were considerably vitiated by the abnormally heavy rainfall.

Fourteen varieties of potatoes were grown for seed in twenty-seven acres and 3,787 maunds were produced, the average yield per acre being 140·25 maunds, the highest yet obtained. Issues for seed were 1,228 maunds and 406 maunds were used as seed on the farm, the rest was sold.

In collaboration with the Imperial Council of Agricultural Research, seeds from various parts of India were planted to test the suitability of Shillong as a potato-breeding centre. This would depend on the extent to which plants ripen and grow berries and seed.

17. Beans and Pulses.

Gram (*Cicer arietinum*). This crop occupied 18,653,000 acres in 1933-34 and 15,822,000 acres in 1934-35. The total yield was estimated at 3,779,000 tons in 1933-34 and 3,671,000 tons in 1934-35. The reported area under improved types was 281,218 acres in 1934-35, of which 131,200 acres were in the United Provinces and 145,972 acres in Burma.

PUSA. The yield trial on eight types was repeated. T 53 and T 58 occupied the first two places. T 53, 55 and 58 have been proved to be definitely high yielders and worthy to rank with the old established types 3, 17 and 25. The hybridization work in progress at Karnal continues to give information on the inheritance of various characters. The root-systems of forty types of *mung* or green gram (*Phaseolus radiatus* Linn.) and twenty-five types of *urid* or black gram (*Phaseolus mungo* L. var. *Roxburghii* Prain), isolated at Pusa, were studied and their relationship with some other characters determined.

On the average of the last three years there are 5,403,000 acres under gram in the UNITED PROVINCES with an estimated yield of 1,399,000 tons. The new varieties of gram, principally of Pusa origin, are steadily spreading.

The PUNJAB has, on the average, 4,700,000 acres under gram. Experiments have shown that no one type of gram gives the highest yield in all parts of the province and hence for different tracts different varieties are recommended. The study of the root-systems of the various good types offered an explanation for these results. An intensive study of the factors responsible for the low yield of Pusa type 1, commonly known as Kabuli gram, showed that the number of pods produced on this valuable but normally low-yielding variety was only one-fourth the number produced on others, like type 7. By increasing the seed-rate of type 1, from the usual 16 seers to 40 seers per acre, a yield about equal to that type 7 was obtained. A one-acre field of type 1 sown at the higher seed-rate produced a yield of 22 maunds. This discovery may have far-reaching results since the Kabuli type sells at double the price of ordinary gram, and would be a most paying crop if such a yield could be obtained regularly.

Gram occupies on an average 1,480,000 acres in BIHAR AND ORISSA. At Sabour, eleven types were grown and studied.

In the CENTRAL PROVINCES the average area under gram is 1,280,000 acres. The work of isolating the unit types was continued and 339 cultures were grown for further study. Five strains were tested for yield against the local selection and strains 28 and 62 stood out prominently. Single-plant selections of a Burma variety, which is less susceptible to wilt, were made in order to isolate high-yielding forms. Crosses were made during the year between strain 28 and Cawnpore strain 28 and Burma, Cawnpore and strain 62 and P 17 and Adhartal 5 in an endeavour to combine yield with wilt-resistance.

Pigeon-Pea (*Cajanus indicus* Spreng.) At PUSA the inheritance of morphological characters and of wilt-resistance in a cross between types 5 and 80 was studied and the results were published. The mode of inheritance of a number of morphological characters was studied in a cross between Pusa types 5 and 66. A yield trial with eleven types of Pusa *rahar*, conducted at the Pusa Farm, showed that types 64, 24 and 15 occupied the first three places as regards yield. The indications obtained in the previous years that the severity of wilt (Fusarium) attack in pigeon-peas was greatly retarded if the crop was grown in fields which had been under tobacco in the preceding season, were substantiated by further experiments this year.

In the CENTRAL PROVINCES, the strain 3 has become well established and the demand for seed is increasing. Sufficient seed of wilt-resistant type 38 has been raised to enable distribution to commence and the variety will be grown next season in the wilt-infected areas of Berar.

In BURMA the departmental selection of this pulse (locally known as *pesinngon*) was, in certain parts of Upper Burma, found to be more profitable than rice at the prices ruling during 1934-35 and its cultivation was encouraged by the department. Six types were grown and two, Theikpan and Pusa 34, were multiplied. The selection of *pesinngon* for resistance to insect attack and light-coloured seed was recommenced. Enquiries regarding the market requirements of this crop were made.

In BENGAL, two very early types of *arhar*, Bankura 6 and Bankura 15, were tried at Bankura and were multiplied at Suri. A statistical examination of the yields of eight Comilla selections showed no significant differences.

Peas (*Pisum sativum* L. and *P. arvense* L.). At PUSA, the yield trial of five types was repeated and the variety T 14-1 was found to be the best yielder. The classification and description of these types was in for publication.

Lentils (*Ervum lens* L.). At Pusa six hybrid lentils were tried for the second time against two very high-yielding selections. The experiment will be repeated again and results computed on the basis of the combined results of three years. The study of the inheritance of flower and seed colours in a number of crosses was completed.

CHAPTER III.

RESEARCH IN CROP PRODUCTION*

Agricultural research in India received a severe blow in January 1934 when the Central Agricultural Research Institute, which is maintained by the Government of India at PUSA, Bihar, was practically destroyed by the great Bihar earthquake. The Phipp's Laboratory, containing the library and the laboratories of agricultural chemistry, mycology, entomology and bacteriology, was completely wrecked and many smaller buildings and quarters heavily damaged. This serious damage to the most important centre of agricultural research in India raised a question which had been slumbering for a long time. Pusa, although offering a good soil and climate, had always suffered from the very serious disadvantage of being difficult to reach owing to its separation from the main lines of railway by a difficult river-crossing and its remoteness from the main streams of national life in India. It was becoming more and more evident every year that the largest and the most complete agricultural library in the country and the best-equipped laboratories could not be used to the fullest advantage when they were isolated from other centres of scientific work. It was therefore decided that it would be better to erect a new institute at some more accessible centre than to expend a large sum in repairing an institute which was in a situation far from ideal. A suitable site for the Agricultural Research Institute was found in Delhi at a distance of about four miles from the Imperial Secretariat and work was commenced in December 1934 on the new site. It is expected that most of the buildings will be completed soon and that the fitting up of the laboratories and the transfer of staff and equipment will also be completed by September 1936. The Institute, which is being built, is laid out and constructed in accordance with the most modern principles. The unit system, by which the laboratories dealing with each branch of agricultural science are separate structures, has been adhered to, and in its new situation the Imperial Agricultural Research Institute should play an even larger part in research and investigation in agriculture than it has done in the past.

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1. Soils and Fertilizers.

Research and investigation on soils and fertilisers during the period under review proceeded on lines similar to those in previous years. These studies included the measurement of the physical, chemical and biological characteristics of the soil and their interpretation in terms of the soil's capacity to grow crops to maturity. Considerations of space do not permit a discussion of all the work carried out in India during the two years under review. The report is, therefore, restricted to the more important lines of work. Fuller and more detailed information may be obtained from the annual reports of the Imperial Institute of Agricultural Research and of the research institutions in the various provinces.

(*a*) ***Soil-surveys.*** In MADRAS and BIHAR, the soils of the several experiment stations were subjected to detailed study. The soils of the area to be commanded by the proposed lower Bhavani irrigation project in MADRAS were surveyed with special reference to their suitability for irrigated cropping. In BENGAL, a survey of the Dacca District was commenced, particular attention being paid to soils from riverine areas. With reference to the economic enquiry into the cost of production of crops, laboratory analysis of soil samples in addition to general field examination was also undertaken. In BURMA, a soil-survey of the typical sugarcane tracts was in progress. In the PUNJAB, soil and under-ground water survey in the Batala-Jandiala tract of Gurdaspur and Amritsar districts was carried out. The quality of the under-ground water in this tract was considered suitable for irrigation. A similar survey of the tract irrigated by tube-wells in Lahore district indicated progressive soil deterioration due to the saline nature of the water of the tube-wells. The clay fractions of some soils of the CENTRAL PROVINCES were submitted to fusion analyses at Nagpur. No appreciable difference was observed in the silica : sesqui oxide ratios of black soil derived from different rocks. Black soils possessed a higher ratio than red soils. The survey of the soils of Onattukara in TRAVANCORE with reference to manurial requirements was in progress. The soils were found to be deficient in all the major manurial ingredients. Similar surveys were in progress in the Trichur taluq of COCHIN.

(*b*) ***Base-exchange and related soil properties.*** At PUSA, investigations with normally acid and de-saturated soils showed no relationship between the amount of lime water necessary to bring the soil to a definite p_H value and the lime-requirement as determined by several well-known methods. The investigations on the nature of the reactions responsible for soil-acidity were continued by Professor J. N. Mukherjee in the laboratories of the University College of Science, Calcutta. Colloid systems of aluminium hydroxide, silicic acid, humic acid, acid clay colloids and solutions of sparingly soluble organic acids were under investigation. On the basis of titration curves obtained for silicic acid soils, colloidal acids were found to exhibit properties different from those of acids in true solution. The Irrigation Research Laboratory in the PUNJAB continued to interest itself in the methods of base-exchange analysis of soils and proposed methods for the determination of exchangeable potassium and sodium. According to studies at Nagpur in the CENTRAL PROVINCES, the light rice soils of the Province possessed a lower p_H value than the heavy rice soils and the transference of a heavy wheat soil into a rice field resulted in the lowering of the p_H

value corresponding to the loss of lime by leaching. Investigations in SIND showed that in the 'Solonetz' group of soils in that province, the most predominant base was calcium. The p_H value of 'sweet' land was found to be about 7·5 and 8, while that of '*kalar*' soils was found to be as high as 9·0. At this reaction value, the nitrogen-fixing power of soil was found to be almost negligible even after the addition of organic matter in the form of green manure.

(c) Soil and irrigation. Carefull investigations by the Irrigation Research Laboratory in the PUNJAB, on the rise of water-table in the Upper Chenab canal, revealed high correlation between the rise of water-table and monsoon rainfall, but not between water-table and the amount of irrigation water applied. The rise in water-table and the increase in irrigation were mutually exclusive. It seems that water added as irrigation water is largely dealt with by the crop, but that the rain falling on three-fourths of the commanded area which is uncropped during *kharif* must be removed as run-off if considerable additions to the water-table are not to take place. It is rainfall during the monsoon which is responsible for permanent additions of water to the water-table. It was concluded that the rise in water-table can be controlled by relatively shallow storm drains in an area of rising water-table which is not already water-logged. Hydro-dynamic studies were made in the same laboratory, on the effect of the gradient of the water-table in the subsoil and on the direction of flow from the bed of canals. Experiments conducted on models in the laboratory agree with the hypotheses developed from field studies in regard to the direction of flow. In BENGAL, experiments to evaluate Damodar canal silt showed that the quantity and quality of silt varied from time to time and that the canal silt was very rich in the major plant nutrients. In SIND, experiments on the reclamation of *kalar* land was continued at the Agricultural Research Station, Sakrand. The greatest success was attained by the adoption of a combination of mechanical and agronomic methods of reclamation. The co-operative investigations of the chemical and agricultural sections showed that the reclamation of *kalar* lands would be possible by a judicious application of irrigation water for leaching purposes supplemented by systems of suitable crop rotations. The observations on sub-soil water indicate that in many areas the problem of the future will be the prevention of excessive rise in the sub-soil water-level and formation of *kalar*. Leaching experiments were carried out using a total of 32 inches of water in four weekly-instalments of eight inches each. The plots were then sown to 4 F-18 American cotton. Analysis of the soils before and after leaching showed that over fifty per cent. of the total salts and eighty to ninety per cent. of chlorides were removed in the leachates. The yields of cotton *kapas* varied from 1,000 to 1,600 pounds per acre. The effect of chemicals like calcium chloride, gypsum and super-phosphate on salinity were tested. Calcium chloride at one ton per acre was found to be most effective, but the cost was prohibitive. Gypsum at two tons to the acre was not very encouraging in two successive years. Super-phosphate behaved more or less like gypsum, so far as salinity was concerned; but owing to the action of phosphate the crop was vigorous and yielded better. All the experimental work under the post-Barrage conditions emphasises the importance of economy and care in the distribution of irrigation water. The sub-soil water-level investigations conducted by the Development and Research Division of Sind Public Works Department have shown that in certain areas of the Barrage zone, sub-soil water-levels are not more than a few feet below ground-level. In the PUNJAB, the study of the economics of reclaiming *bari* soil with calcium salts was continued on the Montgomery farm. Contrary to the results obtained in Sind, the gypsum-treated plots showed marked improvement over controls, while in the calcium chloride-treated plots the improvement was not so great.

(*d*) *Soil-moisture.* In the laboratories of the Agricultural Meteorologist at POONA, detailed observations were in progress on the pressure of water-vapour and degree of saturation in the air-layers near the ground during winter of 1933 at different hours of the day. The available results showed that the soil lost moisture during the day due to evaporation and recouped this loss at night by absorption of moisture from the air-layers near the ground. Each type of soil had its own characteristic variation. In the same laboratory observations on the factors responsible for the attainment of temperature in soils showed that though watering lowered temperature suddenly the recovery from the effects of wetting was gradual.

In BENGAL, the movement of soil-moisture during dry months was studied leading to the usual relationship between moisture-content and time-factor. Working with paddy, a moisture-content below thirty-three per cent. of the soil's saturation capacity reduced the yield of paddy. Investigations were also in progress to find out the equilibrium distribution of moisture along vertical column of soil. The results showed a linear relationship between moisture-content and the height to which water rises by capillarity.

(e) *Soil-microbiology.* At Lyallpur in the PUNJAB, the absence of nodule bacterium of berseem (*Trifolium alexandrinum*) was noted in the mossy soils of the Punjab and inoculation was necessary for the successful growth of crops. The tops and roots of berseem grown from inoculated seed contained 2·43 per cent. and 1·58 per cent. nitrogen respectively as against 2·05 per cent. and 1·25 per cent. nitrogen in the tops and roots respectively of plants grown from uninoculated seed.

At PUSA, studies were carried out on the effect of maize root washings on nitrogen-fixation in culture media. It would appear that the maize roots provide products capable of stimulating nitrogen-fixing organisms present in the soil inoculum when added to Ashby's mannite solution. In the PUNJAB, studies on the microbiology of the progressive reclamation of alkali soils revealed close correlation between bacterial numbers and extent of correlation. There was also correspondence between crop-yields and bacterial numbers. Investigations at Pusa have shown that, using Azotobacter as the test organism, the plaque method was a useful means of distinguishing between the availability of different phosphatic fertilisers, of measuring the effect of soil-acidity and of estimating lime-requirement of soils.

(*f*) *Soil nitrogen.* An estimate of the amount of nitrogen added to the soil by rain at Sylhet in ASSAM during twelve consecutive months, showed that the nitrogen values were very much in excess of those for other localities. The Sylhet rain contained a higher percentage of nitric nitrogen and ammonia than the values previously recorded at Dehra Dun and Cawnpore in India and at Rothamsted in England. Investigations on the recuperation of nitrogen by soils under irrigation in the BOMBAY Presidency were commenced during the period under review. Comparative studies at PUSA of the processes of nitrification in highly calcareous soils, and non-calcareous soils, showed that accumulation of ammonia was greater in the calcareous than in the non-calcareous soil, while the extent of nitrification was similar in both cases. The relative rates of nitrification of different oil-cakes and of ammonium sulphate in the black cotton soils of Malwa plateau, under different conditions of light and humidity, were studied at INDORE. Under all conditions nitrates decreased rapidly in the third week but no loss of nitrogen was observed. The algal growth which appeared simultaneously with the fall in nitrate content was considered responsible for the decrease in nitrate nitrogen. Similar comparative studies at Poona on the nitrification of different oil-cakes in medium black, laterite and garden soils, showed results contrary to the findings at Indore. Nitrogen loss occurred in all the soils. The nitrification and the extent of nitrogen loss varied both with the nature of soil and the oil-cake used. Black soil was the most and laterite soil the least active both in regard to ammonification and nitrification. The loss of nitrogen was greatest with the most easily and quickly nitrifiable cakes.

Investigations at Pusa have shown that in some soils no accumulation of nitrate occurred for twenty weeks after inoculation, although fairly large amounts of ammonia accumulated in two or three weeks. It took sixty-seven to seventy-one weeks for the complete nitrification of cyanamide. The retardation in nitrification was attributed to the formation of dicyandiamide which persisted long in the soil and was toxic to nitrifying bacteria.

(*g*) ***Photo-nitrification.*** Careful experiments in the laboratories of the Imperial Institute of Agricultural Research, PUSA, so far failed to provide evidence in support of the findings of the University laboratories at Allahabad, that nitrification in the soils of tropics was more due to photo-oxidation of ammonia and its salts accelerated by catalysts than to the action of bacteria. On the other hand, the photo-nitrification school of ALLAHABAD produced further evidence in support of their previous findings. They also showed that marked evidence of photo-denitrification occurred when solutions of ammonium salts or mixtures of ammonium salts and alkali nitrate were exposed to sun-light. At Lyallpur in the PUNJAB, photo-nitrification of certain organic compounds was under investigation. Using one per cent. solution of urea, uric acid, hippuric acid, glycocoll, ammonium acetate, dicyandiamide, mono-ethyl amine and di-ethyl amine, appreciable photo-oxidation of nitrogen was observed in the presence of zinc oxide. Sterile soil was much less efficient than zinc as a catalyst. Animal charcoal was more efficient than zinc oxide as a catalyst for the oxidation of ammonium sulphate but sterile soil had no effect.

(h) Soil organic matter. Investigations at BANGALORE on the oxidation of organic matter in dry as well as swamp soils showed that the soil organic matter could be easily oxidised by chemical agents like chromic acid. In BOMBAY, the decomposition of different plant materials in soil was studied under laboratory conditions. Under optimum conditions of temperature, moisture and aeration, docomposition depended on the chemical constituents of the plant materials. With balanced proportion of available carbo-hydrates to available nitrogenous compounds, the decomposition of the materials was rapid. Those having an excess of nitrogenous compounds decomposed more rapidly than those materials which contained an excess of carbo-hydrate compounds, irrespective of the leguminous or non-leguminous character of the plant. With tender green materials there was loss of nitrogen.

At PUSA, a significant amount of nitrogen-fixation was observed in soil cultures containing artificial manure made of fermented straw. Aqueous suspensions of cow and horse manure after aeration for three weeks fixed atmospheric nitrogen, the organism concerned being *Clostridium.*

(i) Organic manures and composts. Work on the development of methods for the conversion of agricultural and domestic wastes into useful organic manures continued. At BANGALORE composts from agricultural and road wastes with activated sludge as starter were continued. At COIMBATORE the results of experiments on composting several kinds of crop-residues into manures were carried out. In Mysore using an emulsion of night-soil as the inoculam, street refuse containing paper, rags, card-board, straw, weeds, leaves of avenue trees was successfully converted into an organic manure. At INDORE, the process of making composts received further attention. Farm wastes were exposed in heaps to rain, and suitable legumes were grown on moist heaps. This procedure hastened rotting and within four months rich composts were ready. The Indore method of composting as described by Howard and Wad was under trial in SIND. The material obtained was tested both on the fields and in the laboratory. No advantage was obtained in the field and laboratory trials revealed that the product was immature and not well decomposed. It was considered that the Indore method as described was not suitable to Sind conditions. According to Sind experiments, composting in heaps above ground was better both in regard to decomposition and nitrogen content than composting in pits as in the Indore method. The incorporation of green matter with the dry raw materials that form the basic material for compost heap or pit, promoted rapid decomposition but entailed loss in nitrogen. In TRAVANCORE successful composting methods were worked for the disposal of night-soil and street sweepings by converting them into odourless manures. Three-hundred cart loads of manure were prepared and sold to ryots.

At Bangalore, experiments were carried out on the use of hydrogen-peroxide for measuring the degree of rotting of organic manures or composts. The effect of three and six per cent. hydrogen-peroxide and water on artificial manures was studied. At the two concentrations the difference in action was very little. Hydrogen-peroxide attacked undecomposed straw to a slight extent. Water extracts contained more organic matter and inorganic matter than hydrogen-peroxide but the amount of organic matter in the latter was more constant than in the former.

The use of molasses for manurial purposes were under trial at PUSA, COIMBATORE and BANGALORE. At Pusa, molasses supplemented by phosphates was found to be a useful manure when applied at ten tons to the acre.

At Coimbatore, the value of molasses as manure for swamp paddy was under investigation. Paddy seedlings, when transplanted soon after the application of molasses, did not thrive. Transplantation after a week or ten days after the application of molasses was successful. Molasses alone at seven and a half tons to the acre or a mixture of four tons molasses plus one cwt. ammonium sulphate gave almost identical and significant increases in yields of paddy grain. In regard to the bio-chemical changes that take place on the addition of molasses, the preliminary work at Coimbatore showed that under swamp conditions (i) the sugars disappeared completely in twenty-four hours. (ii) There was at first alkalinity but with proper drainage, alkalinity slowly disappeared to a neutral point. Ammoniacal nitrogen gradually increased daily, reached a maximum and then remained steady. (iii) An enormous increase in bacterial population occurred in about six days after the application of molasses, the increase being greater in the drained than in the un-drained pots. (iv) Yeasts and algae were not observed in molasses-treated soils. (v) During the period of vigorous fermentation of molasses, the composition of the evolved gases was made up of a large percentage of carbon dioxide, some hydrogen and very little methane. No elemental nitrogen was detected at any stage of fermentation. Lactic acid increased rapidly up to ten days followed by a gradual decrease indicating the use of the acid by micro-organism as a source of energy. In the Bangalore laboratories lactic, acetic, propionic and butyric acids, minute quantities of ethyl alcohol, acetal dehyde and fusel oil were detected as the products of the decomposition of molasses under swamp conditions. The Bangalore workers also noted dissolution of soil minerals as the effect of molasses.

In BURMA, investigations were in the direction of utilising molasses for manufacturing alcohol. In experimental investigations yields as high as one hundred London Proof gallons per ton of molasses were obtained.

At Sabour in BIHAR, experiments were in progress on the agricultural use of molasses. Laboratory experiments showed that the large amount of carbon had not exercised the effect of locking up the nitrogen of the soil. In the field, when applied at twenty pounds nitrogen per ton, small increase in the yield of paddy was obtained.

Fertilisers.

At BANGALORE interesting experiments were carried out on the effect of oxidising agents on soil and crop. Vigorous oxidising agents such as potassium permanganate or hydrogen-peroxide were effective in increasing crop-growth when these oxidising agents were applied either before or simultaneous with the application of organic manure. As top-dressings, they tended to depress yield. On the other hand, milder agents, like the oxides of iron or manganese produced the most favourable effects when applied as top-dressings at least a fortnight after sowing or transplanting as the case may be. Oxidising agents slightly favour the ammonification of organic matter, while no appreciable improvement in nitrification was noticed. The effect of the addition of oxidising agents was an immediate increase in the numbers of bacteria and actinomyces, on manured as well as unmanured soils, but the numbers gradually fell off to the previous level in the next fortnight after the addition of oxidisers. On the other hand, the decomposition of organic matter is considerably hastened.

At PUSA, the interaction between super-phosphate and highly calcareous soils was under study. The high calcium sulphate content of super-phosphate was responsible for the precipitation of soluble phosphate into insoluble calcium phosphates leading to a reduction in the concentration of available or soluble phosphate, and to an increase in the concentration of sulphate ions. This concentration of sulphate tended to retard nitrification and nitrogen fixation.

In BURMA the results of phosphate applied to Mudon paddy soils were interesting. The Mudon soils were subject to heavy rainfall and it was suspected that the erratic crop results were due to the phosphate being carried down into lower layers. Studies of the ratio of available P_2O_5 at the surface to sub-soil at 18″ to 36″ depth showed that the supposition that phosphate passed into lower depths was not justified.

Various methods for making bones brittle for easy pulverisation without the use of machinery were under investigation. At PUSA and POONA preliminary treatments with sodium hydroxide, sodium carbonate, boiling water, autoclaving at 140°C, and dry heating at 150°C, and simple charring of the bones were tried. While all treatments made the bones more or less brittle, charring them in direct contact with fire was found simpler and more practicable although there was loss of nitrogen.

According to experiments at Pusa, dilute solutions containing a mixture of sodium hydroxide and sodium chloride softened the bones in two months when kept out of contact with air. The crushed meal contained 25 per cent. of organic matter, 30 per cent. phosphoric anhydride, 3·5 per cent. nitrogen and two per cent. free sodium hydroxide.

(*a*) ***Fertiliser practice.*** At POONA the effect of contact of fertilisers with seeds on their germination was investigated. Ammonium sulphate at 100 lbs. to the acre was injurious to the germination of cotton, *jowar* and *bajri* when the seed and salt mixture was dibbled in pinches. The injury was less when the seed and fertiliser were applied together by drilling and was negligible when the two were applied out of contact with each other.

BURMA reported interesting comparative studies with manures and fertilisers on soils of known physical and chemical composition. In comparative experiments with (1) composts made of straw, (2) natural farmyard manure, (3) straw alone, on an equivalent nitrogen basis at fifty pounds to the acre, increased yields of paddy grain by thirty-five, thirty-five and ninteen per cent. respectively were obtained as against 26·5 per cent. for ammonium sulphate plus calcium carbonate. Coarse rice bran containing 1·93 per cent. nitrogen applied at twenty pounds nitrogen to the acre resulted in increased yields of paddy grain from 1·7 to 28·9 per cent. in three seasons.

Water-hyacinth (*Eichhornia crassipes*) compost which contained 0·27 per cent. nitrogen, 0·21 per cent. phosphoric anhydride and 0·76 per cent. potash gave good results when applied at ten tons to the acre.

In contrast to the above, in Burma soils, ammophos, niciphos, leunophos, diammonphos, and other ammonium phosphate fertilisers increased paddy yields in some cases but had little or no effect in others. Super-phosphate and basic slag increased the yields from seven to thirty-two per cent. in different years and on different soils. Urea and calcium cyanamide were not as effective as ammonium sulphate on paddy.

In BENGAL, the investigations on the optimum ratio of nitrogen to phosphoric acid for paddy appeared to be 1 : 1 for silts and 1 : 3 for red soils. In MADRAS such ratios for paddy were 1 : 3 without a basal dressing of green manure and 1 : 1 on a basal dressing of green manure. For *ragi* (*Eleusine coracana*) a ratio of one of nitrogen to two of phosphoric acid was the optimum in the absence of green manure. When green manure was applied, there was no response to additional dressings of phosphates.

In the BOMBAY presidency, interesting experiments on the movement of fertilisers in the soil were carried out. Studying the movement of ammonium sulphate in typical soils of the Presidency and under varying conditions of moisture, it was observed that diffusion of the fertiliser increased with rising moisture-content of the soil, the maximum diffusion being a distance of six inches from the point of application, in soils having a moisture-content of fifty to seventy-five per cent. of the soil's water-holding capacity. The sulphate of ammonia diffused in all directions and the distance to which it diffused was the same for horizontal, downward and upward directions. In the course of diffusion, a part of the ammoniacal nitrogen changed into the nitrate form and in this form the diffusion was more rapid.

(*b*) ***Fertilisers and crop quality.*** Experiments at PUSA on the effect of fertilisers on the quality of sugarcane showed that although nitrogenous manures improved the yield of crop, the quality of the juice was lowered. Sulphate of potash and super individually improved quality.

At Palur in MADRAS sodium nitrate, either alone or in combination with groundnut cake, was inferior to ammonium sulphate as a source of nitrogen for sugarcane. In regard to quality, *gur* or jaggery produced from cane fertilised with ammonium sulphate was of poor quality and this defect was more in evidence with increase in the amount of ammonium sulphate used.

The Tea Research Station at Tocklai in ASSAM recorded some important and interesting observations on the effect of fertiliser treatment on the composition and quality of tea.

Phosphate application either with or without potash increased the phosphate content of tea leaf, throughout the season. The application of potash or nitrogen tended to increased phosphate content of the leaf. Likewise the potash content of leaf manured with potash was significantly higher than that of leaf manured with nitrogen only or in combination with phosphoric acid. The ratio $K_2O : P_2O_5$ in tea was lowest in 'made-tea' which was ranked as the highest in quality, while this ratio was highest for 'made-tea' ranked as the lowest in quality.

Although the differences were small, the average moisture content of the leaf manured with nitrogen plus phosphate, was significantly higher than that from un-manured plots, while the moisture-content of leaf manured with complete mixture was significantly higher than that of leaf manured with phosphate and without potash.

In regard to the quality of tea as a beverage, as judged by the opinions of tea-taster, it was found that phosphate improved and potash tended to impair quality. The two effects were additive.

Tea made from leaves plucked from cattle-manured plots was better than that from un-manured plots but not significantly different from the tea from chemical-manured plots, but in the tea-tasters' classification, the tea from cattle-manured plots consistently occupied a higher position than that from chemical manure.

2. Agricultural Meteorology.

The scheme on agricultural meteorology, approved by the Imperial Council of Agricultural Research in 1930, was actually inaugurated in 1932, and the Agricultural Meteorology Section began to function at the Meteorological Office, POONA, in August 1932. During the period under review, progress was made in organising work on several different aspects of this new subject. The programme of the section may be divided into (*a*) experimental or biological, (*b*) statistical, and (*c*) general. Contact with agricultural departments and institutions during the first year showed clearly that the section, in order to achieve results and render services of immediate value to agricultural workers, will have to devote a good deal of its time to work on the "experimental" and the "liaison" aspects of the scheme.

EXPERIMENTAL.

1. *The Central Agricultural Meteorological Observatory.* To study the climates of air and soil layers near the ground in the open as well as inside different crops and to evolve methods of measuring these with the help of specially designed instruments is one of the tasks before the section. For this purpose a "Central Agricultural Meteorological Observatory" has been started on a well-exposed site in the farm of the Agricultural College at Poona. The site was kindly provided by the Bombay Department of Agriculture and most of the instruments which had to be ordered from abroad were received, standardised, and installed by December 1933. A small field laboratory was also erected at one corner of the site. The observatory has the status of a first class station with gradually improving facilities for the investigation of (1) the climate of open spaces as compared to the climates within different crops; (2) the movement of water and heat through the air and in soil layers near the ground; (3) evaporation from free water and soil surfaces; (4) effective rainfall and (5) solar, terrestrial and sky radiations. The observatory is unique for the completeness of the scheme of instruments and measurements which provide all the data for evaluating the different factors which control the ultimate disposal

of the solar radiation arriving at the earth's surface, *i.e.*, of the " thermal balance ". Attempts are also being made to evolve a series of measurements with suitable instruments for studying the water " balance " at the earth's surface. Besides being the centre for carrying on these fundamental investigations, the observatory is also serving as a training ground for the numerous agricultural workers who are interested in agricultural meteorology.

2. *Design and trial of new instruments.* Among the new instruments designed by the Agricultural Meteorology section may be mentioned (*a*) a new type of open-pan evaporimeter with a measuring gauge, (*b*) portable percolation gauges, (*c*) a standard thermo-couple set for the accurate measurement of plant temperatures, (*d*) soil evaporimeters with bottom feed, (*e*) portable screens for the exposure of meteorological instruments inside crops, etc.

Some of these instruments have passed the trial stage and are already in use at many experimental farms.

3. *Micro-climatology.* By " micro-climate " is meant the climatic conditions in the air near the ground both in the open and inside various environments. The measurements of temperature and humidity made from instruments kept in the standard Stevenson screen at a climatological station indicate the conditions in a region well removed from the immediate disturbing influences of the ground. These measurements indicate the " macro-climate " or the general climate of a locality. The " micro-climate " differs widely from this general climate and, when we wish to study the environmental factors of different crops, gardens, forests, etc., the careful measurement of the " micro-climate " becomes an important task. Records of the micro-climates of the " open " as well as of different crops growing in the farm at Poona show that each crop modifies the general climate in a characteristic way. Simultaneous observations in the open and inside a sugarcane crop show, for example, that the temperatures differ from each other by as much as 10°C. in the air-layers very near the ground. The micro-climate of crops are not related in a simple way to that of an open space in the neighbourhood so that it becomes essential to measure it systematically side by side with the rate of growth, leafing, flowering, etc., of

the crop during its growing season before we can hope to express the final yield as a function of the various weather factors. The Agricultural Meteorology Section is also taking "precision observations" on selected crops side by side with the observations of their micro-climates. Other centres in India are also beginning to co-operate in this fundamental work.

The study of micro-climate during clear weather has also brought to light the part played by various physical processes such as conduction, radiation, turbulence, etc., in nocturnal cooling and the resulting stratification of the air-layers near the ground. It is found that, contrary to accepted theories, the lowest air-temperature at night occurs not at the surface but at some distance above the ground, both in the open as well as inside crops.

Another interesting investigation which has thrown considerable light on the adsorptive properties of different soils is on the exchange of moisture between the soil and the air layers above it during clear weather. The water lost to the atmosphere by the soil during day-time is more or less regained by absorption from the atmosphere at night. The diurnal variation in the moisture-content of the soil-surface is seen to be maximum in the black cotton group of soils, moderate in the red laterite soils, and minimum in the alluvial soils. These phenomena also bring about an increase of moisture-content with height in the air-layers near the ground during night and a decrease with height during day.

4. *Soil temperatures.* Progress was made in the study of soil temperatures in relation to the colour of the soil by laying out a series of plots covered with thin coatings of representative soils from different parts of the country. Some of the covers were found to modify profoundly the climate of the local soil below. A cover of chalk powder, for instance, lowers the soil temperatures by 10° to 15°C. at the surface, 5 to 8°C. at 5 cm., 4 to 6°C. at 10 cm. and so on. The effect of wetting the soil surface with known quantities of water and the effect of a crop on soil temperatures were also under investigation.

5. *Evaporation, percolation, etc.* Under evaporation, the work included the comparison of different types of instruments mostly

of local construction. Percolation of water was investigated with the help of locally-designed gauges filled with different depths of soils.

The evaporating power of the atmosphere in different parts of India was also computed from other meteorological factors. A general study of the possible evaporation in India was made with those computed data and it was shown that except during the South-west Monsoon, the Bombay Deccan and adjoining tracts represent the area of maximum possible evaporation. It is hoped that with the installation of evaporimeters at a large number of centres in India, it will be possible to study this phenomenon which is of such vital interest to the agriculturist, the irrigation engineer, the salt manufacturer, etc.,.in greater detail.

6. *Radiation.* Radiation is one of the most fundamental factors in meteorology, as well as in biology, and no scheme of meteorological or biological studies would be complete without a detailed study of this factor. Measurements of the intensity of solar radiation in different regions of the spectrum, the intensity of the total radiation from the sun and sky, the intensity of the heat radiation from the night sky, the albedo of different types on soils, etc., are being made at the observatory.

7. *Frost.* The study of (*a*) meteorological factors during frosty nights, (*b*) statistics of past cold waves in India and the frequency of frost temperatures in different parts of the country and (*c*) methods of preventing damage to crops was also undertaken by the Agricultural Meteorology Section. During the intense cold waves of January 1935, a special camp observatory was set up in a vineyard at Nasik to study the conditions during frost. Arrangements were also made to issue frost warnings to the Nasik area, and these warnings were much appreciated by the vine-growers. It is hoped that other agriculturists in North-India will also take advantage of such warnings.

STATISTICAL.

The work on the statistical side included (1) the analysis of the data collected at the Central Agricultural Meteorological Observatory, (2) the analysis of past meteorological statistics bearing on agricultural problems, (3) the analysis of statistics of cotton outturn in India in relation to meteorological and other related factors, (4) the analysis of crop-yields and meteorological factors recorded at experimental farms and (5) statistical advice to agricultural workers interested in agricultural meteorology.

A number of investigations were in progress under the different heads mentioned above. The analysis of the dates of onset of South-west Monsoon in different parts of India during a series of forty-two years, the study of the monthly rainfall in Mysore, and the study of correlation coefficients of monthly maximum temperatures at selected stations in India with a view to exploring the possibilities of temperature prediction were some of the investigations made during the period under review.

The study of the influence of weather factors and prices on the outturn of cotton in the Bombay Presidency has been completed. The investigation is being extended to the cotton districts of Berar and the Central Provinces. The discussion of these results is in progress. The yield per acre of cotton is seen to be dependent, among the weather factors investigated, upon the rainfall in the early and late monsoon months and the temperature in the months of September, October and November.

With regard to data collected at experimental farms the study of the yield of wheat at the Cawnpore Agricultural College and the yield of cotton at Akola, in relation to rainfall in five-day periods during the growing season, have been completed. A preliminary study of the yield-data of some of the important crops at Government farms for periods ranging from ten to twenty-six years has also been completed.

Statistical advice has been given to a number of workers who are co-operating in work on Agricultural Meteorology.

GENERAL.

Co-operation with agricultural workers. The co-operation of the Agricultural Meteorology Section was extended to agricultural departments and workers in different provinces and Indian States in various ways.

Agricultural meteorological observatories. Barring a few exceptions, most of the experimental farms in India have very meagre meteorological equipment. Since the creation of the Agricultural Meteorology Section, most of the provinces and Indian States have begun to take interest in this matter, and have arranged or are arranging to equip selected farms with standard meteorological equipment as specified by the Section. Besides rendering such advice, help was given also by training at Poona a number of agricultural workers from different parts of India in routine meteorological work as well as in micro-climatological studies,* by standardising their instruments after repairing where necessary, and by giving them instruction for setting up the instruments.

Within the next few years it may be hoped that the activities of the Agricultural Meteorology Section in this direction will result in a number of agricultural centres in different parts of the country, having uniform equipment and collecting detailed observations of weather and crops side by side in a systematic manner.

Apart from the above extension of work in systematic agricultural meteorology, it may be mentioned that a number of workers in charge of the various research schemes financed by the Imperial Council of Agricultural Research discussed the meteorological aspects of their respective problems with the Agricultural Meteorologist besides getting their assistants trained, instruments standardised and observatory plans laid out. These officers sought the advice of the section about their special difficulties and raised many problems of interest for investigation. In this connection special mention may be made of the following :—

(1) Dry Farming Research Schemes at Sholapur and Bijapur (Bombay Presidency), at Hagari (Madras Presidency) and Raichur (His Exalted Highness the Nizam's Government).

(2) Sugarcane Research Schemes at Padegaon (Bombay Presidency), Shajahanpur (United Provinces) and Muzaffarpur (Bihar and Orissa).

(3) Locust Research Schemes at Karachi and Pasni.

The problems relating to the conservation of moisture in the case of (1), measurement of water-content in the soil and of temperatures of plants in the case of (2) and the study of Locust meteorology in the case of (3), engaged the attention of the Agricultural Meteorologist. The experience in the study of micro-climates gained by the Agricultural Meteorology Section was of special value to all these investigators.

3. Plant-breeding and Genetics.

Plant-Breeding is concerned with the production of crops which are superior in quality or in yielding power to those already in existence. While it is a branch of agricultural science of great importance in all countries, it is of very particular value in a country like India where owing to the limited resources of the *ryot* it is not always immediately possible to adopt improved mechanical methods of cultivation or to apply intensive systems of manuring. The steady development of plant-breeding in India during the period under review shows that this fact has been recognised. Side by side with plant-breeding, researches on the genetics of crop plants have been conducted.

Rice. The ecological specialization of the rice plant makes it necessary to develop a large number of varieties for different tracts of land. Breeding work was carried on at Pusa and at the various rice research stations financed by the Imperial Council of Agricultural Research and by the Departments of Agriculture of the Provinces and States.

All the three principal methods of plant-breeding, *i.e.*, introduction, selection and hybridization, were resorted to. The main object in view has been the production of better quality and better-yielding strains of rice, but attempts were also made to discover drought-resistant, flood-resistant, alkali-resistant and saline-resistant strains. In several instances, breeding was done to meet special requirements. Thus, in the United Provinces, work has been in progress with a view to producing fine-quality paddies with enclosed panicles so that the latter might be immune to the attacks of the rice-bug. In the Central Provinces, endeavour was made to combine high yield and the quality with the deep purple foliage colour of a non-economic variety in order to facilitate the rogueing out of wild rices from the paddy crop. Again in Madras work has been in hand with the object of obtaining good strains possessing resistance to *Piricularia oryzae.* This object has been realised and high-yielding and *Piricularia*-resistant hybrids have been secured from the cross Korangusamba × GEB 24.

A great deal of important genetical work on this crop has been done by Mr. K. Ramiah and his assistants at COIMBATORE. They have studied, in particular, the mode of inheritance of height of plant, flowering duration, grain-length, lodging of straw and the grain-shattering character. While the last-mentioned character behaves as a simple recessive in the progenies of *Oryza sativa* × *O. longistaminata,* it shows a multiple factor inheritance in crosses among cultivated types, exhibiting various degrees of shattering. New mutations have been observed, among them being two tetraploids, one from *sativa* and the other from *longistaminata.* Investigations on the inheritance of a number of characters were also carried out at other stations in Burma, Bihar, etc. The occurrence of albinos and other types of chlorophyll-deficient plants was studied in ASSAM, BURMA, MADRAS and PUSA.

A certain amount of work on the cytology of the rice plant has been carried out and at Coimbatore various forms of sterility were connected to particular chromosome irregularities.

Quality in rice is being investigated under the Imperial Council of Agricultural Research Scheme at the Indian Institute of Science, BANGALORE. The programme of work has been so drawn up as to bear relation to the histological work and storage studies being undertaken at Coimbatore. The main lines of work are directed towards understanding the chemical changes which take place when rice is stored or converted into par-boiled rice.

Collections of rices are now maintained at most of the important rice research centres and are added to from time to time. In many cases classifications to suit the local requirements have been completed.

Wheat. Wheat-breeding continued to be the subject of intensive study in the PUNJAB, UNITED PROVINCES, SIND and other Provinces where this crop is grown. Several new strains of hybrid origin were either released or were in the final stages of field trials. Two new types from PUSA, Pusa 120 and Pusa 165, obtained from crosses between the Australian variety Federation and P 52 and P 4, respectively, were under extensive yield trials in the Punjab, United Provinces and Bihar. Both these wheats are improvements over the older wheats in respect of standing power and rust-resistance and Pusa 165 has also given evidence of being a very high yielder. In the Punjab, four types were released for distribution by the Department of Agriculture and one of these in particular, C 518, combines stiff straw with very high-yielding capacity. Pusa 114 continued to be successful in Sind and C 13 in the United Provinces.

The Imperial Council of Agricultural Research sanctioned a scheme for the breeding of rust-resistant wheats at the Imperial Institute of Agricultural Research with the collaboration of Dr. K. C. Mehta of Agra, and provided a sub-station at Simla where the necessary crossing and subsequent breeding work could be done.

Owing to the fact that physiologic forms of all the three wheat-rusts exist in India, the task of combining resistance to all these in a single variety is a difficult one. There is, however, a hopeful feature in that the number of physiologic forms of each rust so far discovered in India is not large. As the annual toll taken by the rusts in this country is very heavy, this line of work should prove of much value to Indian agriculture.

Barley. There has been in the past a dearth of accurate information regarding the suitability of Indian barleys for malting and brewing purposes. With the object of filling this gap in our knowledge and also to ascertain whether the malting and brewing qualities are affected during the long sea-voyage, the Imperial Council of Agricultural Research has financed arrangements for the despatch of samples of barleys from the PUNJAB and BIHAR (the latter including some Pusa types) to England for malting and brewing tests.

The PUNJAB Department of Agriculture has increased the supply of seed of their L 4 and L 5 types which have established their superiority as high-yielding strains. The grain of L 4 is being used for the manufacture of " pearl " and powder-barley products. In the UNITED PROVINCES, the multiplication of C 251 malting barley is in progress and efforts are being made to create and organise a market for this barley both in India and abroad. A preliminary survey of the varieties grown in Bihar has been made at Sabour.

The inheritance of a number of characters in barley was studied at the Imperial Institute of Agricultural Research, PUSA. Of particular interest was a cross between a lodging and non-lodging type of barley in which the inheritance of mechanical tissues was investigated. It was found in this case that the distribution, development and thickness of sclerenchyma was controlled by two factors.

Striping in barley plants was studied at Pusa and also selection of plants resistant to *Helminthosporium* attack was in progress.

Oats. A number of very promising hybrids combining the early maturity and drought-resistance of the B. S. oats and the good grain and profuse straw of exotic types have been bred at PUSA and are undergoing yield trial. The study of inheritance of certain qualitative and quantitative characters was continued. In crosses between *Avena sativa* and *A. sterilis*, it was found that single factors were responsible for the differences observed between *sativa* and *sterilis* types of base of grain, " strong " and " weak " awns and " long " and " short " basal hairs ; two factors were found responsible for the inheritance of basal hairs and hairs on the margins of leaves. Height of plant was controlled by multiple factors.

Maize. This crop has not received so much attention as some of the small grain cereals although collection and study of samples and selection work was done at a number of stations. This is probably partly due to the cross-pollinated nature of the crop, rendering the technique of breeding more complex.

At PUSA, breeding was commenced on an extensive scale and a large number of samples collected from different parts of India were studied. All the cultures grown therefrom proved to be of the flint type and the chief groups as regards seed-colour were white, yellow and orange. They differed markedly in characters such as maturity, height, cob-size, kernel-size and grain yield. Some of the cultures showed promise of high grain yield, while others appeared to be very suitable for fodder purposes. Selection work on these is in hand. The in-breeding work previously commenced was continued and crosses were made between some of the selfed lines.

Millets. In MADRAS considerable work on the genetics of several millets has been done.

In Sorghum, juiciness and sweetness of stalk were found to behave as simple recessives to pithiness and insipidity respectively. The brown colour of the pericarp of the grain has been shown to be due to the presence of two complementary factors, one of which is linked with the factor controlling pigmentation in leaf-sheath and glume.

Certain varieties have dimpled grains. Dimpling was found to be a simple recessive to the normal (non-dimpled) condition. In one variety " short early " plants were observed to be dominant to " tall late ", the pairs of characters going together. An auricleless and ligule-less condition of the leaf was found to be recessive to the normal (auriculate and ligulate) condition.

The tillering of *bajra* (*Pennisetum typhoideum*) was studied and the number of tillers and thickness of peduncle were found to be highly correlated to yield. The mode of inheritance of pigmentation, hairs on leaves, depth of chlorophyll colour and bristles on the head was also studied.

In *ragi* (*Eleusine coracana*) a new type of purple colour was met with and found to behave as a simple recessive to the purple of local varieties.

In *Setaria italica* the inheritance of factors governing intensity and distribution of purple pigmentation was observed.

The chromosome numbers were determined for certain wild species allied to the cultivated millets.

Selection work in the millets was also carried out in MADRAS, BOMBAY, PUNJAB, CENTRAL PROVINCES, MYSORE and other Provinces.

Sugarcane. The very successful work of breeding canes for various parts of India was continued at COIMBATORE, where also considerable attention has been devoted to the cytological investigations of various *Saccharum* species and hybrids. The haploid chromosome number in Puri, Vellai and Shamshara was found to be forty and about forty in Poovan and Chittan.

The Coimbatore form of *S. spontaneum* was found to have thirty-two haploid chromosomes, while Co. 205, a seedling of the cross between Vellai and *S. spontaneum* (Coimbatore) had fifty-six. The chromosome numbers of a large number of varieties and hybrids were also determined.

The testing of Coimbatore and other canes was in progress at many stations. Attempts to produce seeds and raise seedlings at the Sugarcane Research Station at Mushari in BIHAR have met with success. Certain promising seedlings have been distributed to various parts of the Province for trial. Experiments were also carried out at this station with the object of accelerating flowering by giving injections of various chemicals. Hastening of flowering by over a fortnight by injections with $HgCl_2$ 1 : 200 has been reported. In the UNITED PROVINCES it has been decided to replace the system of obtaining seedlings from Coimbatore by one in which seed will be obtained and germinated at Shahjahanpur itself.

Cotton. Work on cotton has mainly followed the lines of studying imported and acclimatised varieties, hybridisation and selection of strains suitable for a variety of conditions.

At the Institute of Plant Industry, INDORE, a botanical survey of cottons in Malwa and Nimar was completed. The survey reveals important and interesting differences in the survival value of different types and physiological work is being undertaken to discover the causes of the differences in plant response. Work on the inheritance of quantitative characters in cotton is being pursued along three main lines :—

(i) the study of genetic variance in relatively uniform material,
(ii) the study of genetic variance in crosses between three important agricultural types of *G. arboreum*, and
(iii) the study of genetic variance in inter-specific crosses.

A study of the inheritance of sterility in cotton has been made at Indore, with the help of two sterile rogues which appeared in a pure culture of 'Million dollar' cotton (grown at Trinidad). One of these sterile plants was distinguished from the rest of the population by its large flowers and complete sterility and a cytological study has shown that sterility in this type is not due to cytogenetic abnormality. The other strain has been shown to carry a simple mendelian recessive factor for sterility. A study of the hybrids between *G. africanum* and cultivated Asiatic cottons has shown that the normal chromosome complement of all plants studied is twenty-six but certain plants contain small 'islands' of tetraploid tissue.

At Coimbatore the crosses between Cambodia and South African cottons proved very promising in respect of yield and earliness and some of the types appear capable of reducing the duration of Cambodia by three weeks, thus cutting down irrigation costs considerably. The three years' trials of strains Nos. 920, 1267 and 1742 showed the superiority of the latter two strains over Co. 2 in yield and earliness and these are multiplied for rapid extension. The segregation of pollen colour in cotton has been described in a paper in the *Indian Journal of Agricultural Science.* It was found that the segregation was sharp and clear-cut and that only one factor was involved in the expression of yellow colour. The presence of different modifying factors was not noticed even in inter-specific crosses and crosses involving different species having pollen of grade 2·5 did not show either intensification or dilution.

BOMBAY. Under the Indian Central Cotton Committee's scheme for the production of a wilt-resistant, heavy-yielding and long-stapled cotton for the Broach tract, four crosses were under study, *viz.*, (1) B. D. 8 × G. A. 26 (fourth generation), (2) B. D. 8 × G. A. 26 F 1 back-crossed to B. D. 8 (second generation), (3) B. D. 8 × 5-7-1 (second generation) and (4) B. D. 8 × S. 12-1 (first generation). Fresh crosses have been made between B. D. 8 and 1027 ALF and B. D. 8 and N. S. 12. At the Dharwar Farm, in replication tests, Dharwar 2 gave significantly higher yields than Jayawant. A new cross Jayawant × 15 has yielded types possessing certain desirable economic characters.

In SIND research has been concentrated on the further improvement of the staple varieties suitable for the Barrage areas.

Attempt has been made in the CENTRAL PROVINCES to replace short, coarse varieties with medium or long-stapled cottons. The strain V 434 continued to be successful as an all-round type.

At the Cotton Research Laboratory, LYALLPUR, the important cross between the Chinese Million Dollar-cotton and the local Mollisoni reached the F_4 generation. In lint-length the cross is far ahead of Mollisoni and approximates to that of 4 F, the commercial medium staple cotton of the Punjab. The F_1 generation of a cross between *G. stocksii* M. Mast and *G. indicum* Gammie have been examined in this laboratory. Three of the plants resembled very much the *stocksii* parent in appearance, while the fourth one was intermediate. All the F_1 plants were sterile. The inheritance of the character ' lintless ' in Asiatic cottons was studied in a joint investigation at Lyallpur and Trinidad, and the results were published. The baffling problem in the Punjab is the periodical partial failure of the Punjab-American cottons. Research directed towards evolving a type of cotton which will successfully withstand the conditions of unfavourable years has borne fruit in the production of an early strain 43 F, which is hardy, resistant to Jassid attack, and less liable to periodical failure. The physiological aspect of the problem is also under investigation. The production of motes in cotton has been studied and the most important cause of their occurrence has been found to lie in a nutritional defect of individual bolls.

Potatoes. Hitherto the position of potato-growing has not been entirely satisfactory, not only in India but throughout the world. A large number of diseases work havoc with the crop and breeding against these has not so far been particularly successful. Perhaps the most difficult problem is that of the virus diseases which in a vegetatively-propagated crop are carried forward from generation to generation. With the discovery of new species in South America by the Russian and other expeditions, however, the outlook has changed, for some of these species possess immunity to blight, a high degree of frost-resistance and several other valuable characters.

A problem which is particularly acute in India is that of rotting in storage. On the plains of India the greater portion of the harvested tubers rot away. This has been studied to some extent in the past, but no method which is practicable on a commercial scale has yet been evolved for combating the loss.

With regard to the work actually done during the period under report, the work already in progress with the object of replacing the present varieties by better yielding and higher quality ones was continued. Towards the close of the period under review, potato-breeding at Pusa was commenced. A sub-station in the hills, where imported varieties including those of the recently discovered South American species can be tested and hybridised with suitable Indian varieties, is being provided by the Imperial Council of Agricultural Research. The Council has also financed a potato research station at Nanjanad in the Madras Presidency.

Tobacco. The most striking feature in this crop is the increasing importance of bright flue-cured tobacco suitable for cigarette manufacture. As the indigenous tobaccos have proved unsuitable for the manufacture of high grade cigarettes, attention has been directed mainly to the introduction of foreign varieties and their testing. At PUSA the strain H. 142, derived from a cross between Pusa Type 28 (an indigenous strain) and Adcock, has been released for distribution and as it combines fine leaf-colour and texture with the hardiness of the indigenous varieties it should fill a want.

A co-operative scheme is also in progress in which nine Provinces and States are participating with the object of determining what areas in India are suitable for the production of cigarette tobacco. Each province is being provided with two flue-curing barns (in a few cases with only one), and three standard varieties of cigarette tobacco are being grown at all the stations. The leaf will be flue-cured at each place and the cured plant subjected to tests by experts. The cost of the barns is being met by the Imperial Council of Agricultural Research, and the Director, Imperial Institute of Agricultural Research, is arranging for the tests of the cured product from different centres.

At the Imperial Institute of Agricultural Research, Pusa, a few sterile plants obtained from a cross between *N. tabacum* and *N. plumbaginifolia* were studied.

Chillies. Selection of thrip-resistant strains was in progress in Madras ; in the Central Provinces classification was done. A detailed account of the inheritance of certain characters in chillies studied at Pusa was published.

Linseed. India is one of the most important oil-seeds producing countries in the world and linseed is amongst the most important Indian oil-seeds. It is widely distributed in BIHAR and ORISSA, the UNITED PROVINCES and the CENTRAL PROVINCES and is also cultivated in several of the other Provinces. The breeding and testing of strains was carried on in most of the Provinces.

Linseeds are generally recognised by the trade on the basis of seed colour as falling into two classes, *i.e.*, yellow-seeded and brown-seeded. According to their size, they are further classified as bold, medium or small. The bold seed fetches a higher price than medium or small seeds, as it is believed to have a higher oil-content. Again, yellow seed obtains a slightly higher premium over brown, as the oil from the former being lighter in colour is more valued. Important research bearing on these two points is being conducted at the Imperial Institute of Agricultural Research, **Pusa.** The results so far obtained do not support the general belief that the larger the seed, the higher is the oil content. Indications were also found of a correlation between seed colour and oil-content; the yellow-seeded types possessed the highest oil-content and the oil-content decreased with increasing darkness of colour. This research when completed is expected to have important economic application.

The investigation of crosses between rust-resistant and rust-susceptible types was continued at Pusa. In F_1, resistance was found to be dominant over susceptibility. In the United Provinces where types resistance to rust have already been secured, attempt is being made to improve these still further in respect of other economic qualities.

On the genetical side, the intensive investigations at Pusa, reported in the last review, were continued.

The F_3 generations of two crosses, Type 12 × Type 24 and Type 21 × Type 24, confirmed the di-hybrid segregations for petal colour observed in the F_2, and the study is expected to elucidate the genetic constitution of Type 24.

Sesamum. Two classifications of types, one from the PUNJAB and the other from BURMA, were published. Photo-periodism in this crop was studied at Mandalay and it was found that the so-called "late" sesamums are short day-types and if they are grown under conditions of long day they tend to produce excessive vegetative growth, reproduction being suppressed or rendered abnormal. On the other hand, the "early" sesamums are capable of being grown successfully both under long day and short day conditions. They do best, however, under the former. The occurrence of phyllody in sesamum was investigated at Pusa.

Work on the production of new strains is in progress in Madras, the United Provinces, Central Provinces, etc.

Safflower. Safflower is cultivated in certain provinces as an oil-seed crop, while in some others it is grown mainly for the sake of the dye which is obtained from it.

Work on this crop was largely confined to the testing of varieties. Cytological work is proceeding in the MADRAS PRESIDENCY.

Brassicæ. The oil-seeds belonging to this group are principally cultivated in Northern India, the largest area being in the PUNJAB.

At Lyallpur, mass-selection has resulted in the production of much improved forms which greatly exceed the unselected local varieties in respect of yield and oil-content and the stage has been reached when some of these can be recommended for general cultivation.

Crosses betwen *sarson* and *toria* have been made with the object of obtaining self-fertile forms of economic value. Such forms would obviate the loss which now occurs in self-sterile varieties whenever cloudy or rainy weather reduces number of pollinating insects visiting the flowers.

Selection work in the UNITED PROVINCES aims at high yield, oil-content and aphis resistance.

The study of self-fertilised types was continued at Pusa. The tentative classifications of the different groups were also checked. The F_3 generations of the crosses previously reported were grown and the F_2 results were confirmed.

Groundnuts were studied in MADRAS, SIND, CENTRAL PROVINCES, MYSORE and other Provinces. In Madras the inheritance of number of useful characters has been studied. Inter-specific hybridisation has been carried out between *Arachis hypogæa,* the common cultivated groundnut, *Arachis nambyquaræ* and *A rosteiro,* two Brazilian wild species. The first generation plants showed the dominance of big-podded nature, ruptured testa and long narrow leaves. The possibility of growing groundnuts as a rotation crop with cotton has been investigated in the Central Provinces.

Gram. Breeding work is mainly directed towards increasing the yield, and to a certain extent to the production of varieties resistant to wilt.

Genetical studies at KARNAL on the inheritance of flower and seed-colours were continued.

Other pulses and legumes. Breeding work was carried out with pigeon-peas, lentils, *mung, urid,* peas, soy-beans, butter beans, etc. The inheritance of certain characters in *Cajanus indicus, Phaseolus lunatus,* etc., was studied.

Fibres. Selection of sunn-hemp types was carried out chiefly in BENGAL and BIHAR, and at PUSA. At the latter place, work is being done in collaboration with the Assistant Fibre Expert, Bengal, with the object of evolving strains of sunn-hemp suitable for Bengal.

Hibiscus.—At PUSA large progenies of crosses between the varieties *Albus* and *Ruber* (*H. sabdariffa*) and between *Ruber* and the New *Hibiscus* were grown to study the effect of time of fertilisation of F_1 plants on the phenotypic segregation in F_2. The results did not indicate that the age of F_1 plants has any influence on the phenotypic segregation in F_2.

Certain crosses between varieties of *H. cannabinus* were also studied.

Fodder crops continued to receive attention.

Fruit trees. An increasing amount of attention was paid to the improvement of mangoes, litchis and other fruits. It is however not possible to present these in any detail within the space of a brief review. For the same reason, breeding and genetical work on a number of crops of less importance than some of those mentioned above could not be touched upon.

4. Plant Physiology.

Cotton. The physiology of the cotton plant has been investigated in SIND, MADRAS and the PUNJAB. All these investigations were carried out under various research schemes financed by the Indian Central Cotton Committee.

Under the Sind Physiological research scheme, studies are being conducted for the purpose of ascertaining the optimum sowing time and irrigation and manurial requirements of cotton in the Barrage area of Sind. The results obtained from the experimental work for the last two years (1933-34, 1934-35) have been in conformity. The irrigation experiments have shown that the water requirements of cotton are the highest during the flowering and fruiting periods and that an initial irrigation of 8 inches during the first 28 days followed in order by two irrigations of about 3 inches each at 20 days interval, three irrigations of about 3 inches each at 15 days interval and 5 irrigations of three inches each at 10 days interval, give the highest yield. The manurial experiments have given best results when compost at the rate of 7½ cartloads per acre was applied, first before sowing and then ammonium sulphate at the rate of 100 lbs. per acre either in one dose when the crop is 3½ months old or in two equal doses, one when the crop is 1½ months old and the second two months later.

Experiments for finding out the optimum time for sowing were discontinued in view of the definite conclusions arrived at. It was proved previously that the optimum period for cotton sowing under Barrage conditions is prior to the middle of May and that sowings even as early as the first fortnight of April give good results. Sowings later than the 20th May give inferior outturns. Investigations of the "Red Leaf" disease have revealed the existence of three distinguishable types of the disease, each differing in incidence, symptoms, appearance and history of attack.

In the Pempheres and Physiological scheme in Madras, the main object of study is the shedding of flowers, buds and bolls in Karunganni cotton caused by untimely rains and other adverse conditions and to bring about reduction in shedding by breeding and physiological methods; also to devise control measures against the cotton stem-borer (*Pempheres affinis*). The preliminary investigations into the shedding of flowers, buds and bolls indicate that boll retention is higher in Karunganni types than in Uppam and that cotton when mixed with black gram has less shedding than when it is sown pure.

Investigations carried out in 1934-35 show that assuming the incidence of attack by *Pempheres* was one hundred per cent., the loss sustained in yield amounts to nearly fifty per cent. of which twenty per cent. was due to the death and the rest to the poor yield of the affected plants. The eight American varieties, Godog, Bourbon, Co. 2, Buganda, 9255, Duranga, Buri and U. 4, were found susceptible in varying degree to the attack of the pest. A few crosses between Co. 2 and some South American types, which were found resistant to the attacks, have been back-crossed to the Co. 2 with a view to obtaining resistant types.

On the biochemical side, it was found that the regeneration of the tissue of the affected plant is confined only to a third larval gallery and is not begun till the pest is at least a fortnight old. It is however interesting to note that Peruvian cotton gums up so rapidly after the attack that insects responsible for the attack die out quickly.

Studies of the biology of the pest have shown that adult borer continues to emerge from the pulled out cotton stalks for a period of two months and lives on the weeds for about three weeks thereafter. This suggests that the pest could be easily controlled if no cotton plants are left in the field for over three months between the harvest of the old crop and sowing of the next crop of cotton. A considerably lower incidence of the pest was observed in localities where the close period of cotton is longer than three months and also where sowings were put off by three weeks in September the crop was free from the pest till January.

In the Punjab, the physiological scheme for the purpose of ascertaining the causes of periodic partial failures of American cotton was started in March, 1935.

Rice. The physiology of the rice plant has been investigated in BOMBAY. The work was undertaken (a) to determine the best period for manuring the rice plant to obtain the maximum effect with a minimum expenditure of fertilizer (b) to study the effect of nitrate nitrogen, ammoniacal nitrogen and a mixture of the two forms of nitrogen on equal total nitrogen basis on growth and yield of the rice plant. As a result of the investigation it was found that the manuring of plants should be done early in August or even at the transplanting stage. Late manuring has very little effect on the growth and yield of the rice plants.

The total nitrogen contents of the plants treated with the mixtures of nitrate and ammoniacal nitrogen was significantly higher than the total nitrogen contents of the rice plants treated with sodium nitrate and of the control plant. The difference between the average of the total nitrogen under mixture treatment and the average of the total nitrogen with ammonium sulphate treatment though not statistically significant was highly striking. The effect on the yields of grain and straw of rice plants under these three treatments was tested in two localities, one with light soil and the other with heavy black soil. In the light soil the mixture gave significantly higher yields of grain than the ammonium sulphate or sodium nitrate. There was no significant difference between the gain yields resulting from sodium nitrate and from control. In the matter of straw yields on the light soil the order of arrangement was found to be, first the mixture, second ammonium sulphate, third sodium nitrate and last the control.

On the heavy black soil ammonium sulphate gave higher yield than the mixture and both these treatments were found to be better than sodium nitrate and all the treatments were better than the control. No significant difference between straw-yields from mixture and ammonium sulphate was observed, and both these treatments were better than sodium nitrate. The control was inferior to all the three treatments.

Potato. Investigations on the pectic changes in the potato tubers at different stages of growth and in storage were carried out in the Botany Department of Royal Institute of Science, Bombay. It was found that there is a regular sequence of changes occurring in the pectic constituents of potato tubers from the very commencement of the tuber formation up to the senescence stage in the storage and that the softening of the tubers is brought about as a consequence of down-grade pectic changes.

Water-hyacinth. The study of the water-hyacinth (*Eichhornia crassipes*) and two other aquatic weeds, *Pistia* and *Salvinia* was made in Bihar and Orissa. The viability, dormancy and germination of water-hyacinth seeds were investigated. Also the drought-resistance of the water-hyacinth plant and the effect of poisons on it were studied. A brief summary from the reports published in the *Indian Journal of Agricultural Science* (Vol. IV, Parts III and VI, 1934) is of interest:—

> "From field observations and experiments in the garden it was seen that the water-hyacinth sets seeds only in the autumn, *i.e.*, in October and November. This fact is of great practical value. It has been the practice so far to search out seedlings during the early rains on account of the fear that pest left undisturbed may be a source of danger. The weed really becomes a perennial source of danger when it produces and discharges seeds into the mud. As the difficulty of distinguishing seedlings from other weeds is great, the weed may be left undisturbed till the middle of the rains and then cleared as the plants can then be easily located. In consequence of this finding, now the executive officers have been asked to see that the tanks are cleared before the end of September.
>
> The seeds lie dormant under water and mud for seven years at least and do not germinate without access of oxygen. If the tanks do not dry up, the seeds cannot get the necessary oxygen for germination. Thus seeds may be prevented from germinating by flooding tanks. Seeds on tank sides lie buried in mud and when a shower of rain exposes them, they germinate freely, and this process goes on from year to year as more and more seeds get exposed.
>
> Experiments with copper sulphate proved most effective. A very low concentration (0·018 per cent.) proved injurious to plants, but it was found that even in strong solutions all the plants were not killed. The reason was found to be the antagonism to copper sulphate of calcium salts liberated by the decaying water-hyacinth plants. This explains why sprays have not been always successful. The lesson from this is that vigilance and mechanical clearing is still necessary even after poisoning the plants.
>
> Investigations into the drought-resistance of water-hyacinth settled on land showed that the plant has the capacity of producing long roots with the progress of drying of the mud on

which it settles. The only effective method to deal with plants settled on the tank sides is to plough them up and expose the roots and thus destroy them. It is a common experience in these parts that *pistia* succeeds in most tanks cleared of water-hyacinth. Although it was found that *pistia* does not cut off light so completely as a thick growth of water-hyacinth does, still a thick growth of *pistia* is obnoxious.

Experiments both in the garden and the field showed that *pistia* can be effectively cleared by spraying with kerosene or better with mixture of kerosene and copper sulphate. Sprayed with kerosene, the plants spread, sink and rot, while copper sulphate (0·06 per cent.) makes the roots fall off, thus killing the plants.

The same methods can be used effectively against the water fern, *salvinia*, which forms matted growth in shallow stretches of water in these parts."

5. Plant Diseases.

Rice. In BENGAL "Ufra" disease of paddy was reported from a number of areas, and a departmental leaflet on this has been issued. Recommendations include improvement of drainage, burning of stubble after harvest, and steeping of seed in salt solution before sowing.

Helminthosporium oryzae was also observed to cause some loss, and ten to fifteen minutes steeping of the seed in two per cent. copper sulphate solution has been recommended. Spraying of seed-beds with Bordeaux mixture was found helpful in ASSAM.

In BURMA, however, extensive trials of fungicidal treatments failed to prevent infection of the crop, indicating that *Helminthosporium* infection is soil-borne as well as seed-borne. Similar experiments carried out in Burma show that bunt (*Tilletia horrida*) cannot be controlled by seed-treatment.

Another disease observed in Burma is associated with the presence of *Cephalosporium* sp. in the lower parts of the plant. The symptoms are incomplete emergence of the ear, and the grain is discoloured and poorly filled.

Blast (*Piricularia oryzae*) has been reported from COCHIN, ASSAM and MYSORE ; in Mysore seed-treatment has been found to give good results.

Foot-rot of paddy was investigated in MADRAS. Several local varieties showed resistance, and seed-treatment with fungicides proved extremely effective.

Experiments at PUSA show that *Sclerotium oryzae* is under Indian conditions, not necessarily a serious pathogen. What appears to be another type of Sclerotial disease of rice is being studied in CENTRAL PROVINCES where it is claimed to cause appreciable losses.

Wheat. The study of bunt was continued at PUSA, and field experiments at Karnal showed that infection can be greatly reduced by seed-treatment. Infection also occurs, however, from the soil, and hence suitable rotation is desirable. Wheat infection by *Tilletia indica* shows a significant decrease in the number of spikelets and in the length of the ear.

"Black point" disease was found to be caused principally by *Helminthosporium sativum.* Infected seed gave poor germination and diseased plants.

Against loose smut of wheat, the simplified heat-treatment of the seed has continued to give good results in the PUNJAB. Seed is soaked in water for four hours and is then exposed to the heat of the sun for about four hours on a bright summer day. Flag smut of wheat is prevalent in the Punjab, and has been found to be soil-borne as well as seed-borne.

The investigation of cereal rusts, financed by the Imperial Council of Agricultural Research, has been continued. An exhaustive search for over summering has been made both at low and high altitudes, and a study of the incidence of rusts in various districts. The physiologic forms of yellow, brown and black rusts have been tested on a large number of Indian and foreign wheats.

Oats. Oat smut has been studied at PUSA; and it has been found that two species occur, *Ustilago avenae* and *U. kolleri,* the latter (covered smut) being more prevalent in Northern India. To avoid the inconvenience of wet seed-treatments against smut, a "dry spray" method with strong formaldehyde solution was given a thorough trial and proved quite satisfactory. One pound of commercial formalin, diluted with an equal amount of water, is sufficient to treat twenty-four maunds of seed.

Barley. In BURMA *Helminthosporium sativum* and *H. teres* were recorded on barley for the first time.

Helminthosporium diseases were studied at PUSA. It was found that seed-treatments, and in particular the mercurial dusts, checks the disease during the foot and root-rot stage, but does not present secondary infection of the leaves from other sources.

Jowar. *Colletotrichum graminicolum* was destructive on *jowar* in BURMA. Seed-treatments proved useless (this agrees with results obtained at PUSA), showing that infection occurs from soil or air. A leaf-spot disease caused by *Cercospora sorghi* is recorded. Against smut, *Sphacelotheca sorghi*, sulphur was found the cheapest effective treatment, but in the CENTRAL PROVINCES copper carbonate is recommended.

In BOMBAY, *Nacrophomina phaseoli*, which is known to occur on seventeen hosts in this province, was found to cause reduction in ear-size of *jowar*.

A new disease which appears to be of virus origin is recorded from MADRAS; affected plants become stunted, the leaves yellow, and no ear-head is formed.

Sugarcane. In BENGAL red stripe-disease was frequently recorded, and an increase has been recorded in the incidence of top-rot.

Cercospora kopkei was widespread in BURMA, but is not a serious cause of loss.

The study of mosaic and other diseases of sugarcane was continued at PUSA under the scheme financed by the Imperial Council of Agricultural Research. Field experiments with Co. 213 have been continued, and confirm the result obtained in previous years, that heavy mosaic infection causes an appreciable loss in yield. An experiment at Patna gave similar results. With the percentage of mosaic infection usually found in Northern India, however, the loss from this cause is insignificant. Much information has been accumulated as to the physical properties of mosaic virus and its transmissibility to sugarcane and to other hosts. Association of mosaic virus with a bacterial cyclostage is reported.

A new bacterial " stinking rot " has been studied, and the causal organism given the name *Bact. pyocyaneum saccharum.* Seedling diseases due to the *Pythium graminicolum* and two species of *Helminthosporium* have been described.

Work on mosaic has been continued in MADRAS. Varieties most resistant to mosaic were P.O.J. 2878, Co. 355, Co. 335 and Co. 205.

Heavily infected Co. 213 showed a decrease of fifteen per cent. in the weight of cane. Mosaic was not transmitted by seed.

Cotton. In Bombay, a disease of which the symptoms are sterility and the production of small leaves is reported to be widespread; there is some evidence that this is a virus disease.

The work on wilt disease carried out at Dharwar under the scheme financed by the Indian Central Cotton Committee for the period 1923 to 1933 was summarised and published. The causal organism is a strain of *Fusarium vasinfectum,* and is capable of being transmitted by seed. Control measures include the use of disease-free seed and heavy applications of farmyard manure during the latter stages of the crop. Early sowing (June to July) has been found to lead to an appreciable increase in yield. For further work on resistant varieties, the necessity for studying the physiologic forms of the fungus is emphasised.

Experiments in Madras showed that seedling blight and boll-rot caused by *Colletotrichum* can be controlled by suitable rotation as the fungus is not capable of living in the soil for more than a year.

In Central Provinces a new anthracnose was studied, and the causal organism has provisionally been named *Colletotricum indicum* Dast. The disease is seed-borne, and is favoured by high atmospheric humidity. Seedling disease caused by *Rhizoctonia bataticola* was found to be partially controlled by seed-treatment.

The root-rot of cotton in the Punjab has been shown to be due mainly to two species of *Rhizoctonia—R. solani* and *R. bataticola.* Further work on this disease is in progress.

Tobacco. Stem-rot caused by *Sclerotinia sclerotiorum* was investigated at Pusa. Infection takes place through the roots or on wounded stems, and the fungus grows best at 20-25°C. Infected plants should be removed and burnt.

In Bengal the *Sclerotinia* disease was not uncommon and reports were also received of collar attack by *Sclerotium rolfsii.*

In Burma, bacterial wilt was reported from one area and in Assam wilt was in some cases bacterial, and in others due to *Pythium.*

Methods for controlling "damping off" disease of tobacco seedlings were tested in MADRAS. Burning trash in the ground before sowing was found to be the cheapest and most effective of the treatments tried.

Some work on tobacco-mosaic virus has been recorded from BOMBAY, under the auspices of the Imperial Council of Agricultural Research scheme for virus studies. The effect of dilution on the thermal death-rate was determined by the local lesion method, and data recorded on the movement of mosaic virus in the leaves.

Potato. In BOMBAY the proprietary fungicide "Kerol" was tested for the control of *Sclerotium rolfsii.* The application of Kerol diluted 1 : 1,200 definitely increased the yield.

Alternaria blight was recorded from several areas in BENGAL.

In ASSAM work on varietal resistance to late blight was started. Diseases included *Fusarium* wilt, bacterial wilt, *Rhizoctonia* and storage-rots.

Storage experiments were carried out in Central Provinces. Storage in brick-lined pits and in charcoal were both unsatisfactory.

Gram. A *Fusarium* wilt was recorded in BENGAL and wilt-resistant varieties are being tried.

In the PUNJAB the investigation of blight due to *Phyllosticta rabei* was continued. The disease is seed-borne, and is also carried over from year to year by infected gram debris left in fields and around threshing floors; such debris should be burnt or buried in the soil. Steps have been taken to ensure the distribution of clean seed and the destruction of infected plant refuse. Of 185 varieties of gram tested, only three French varieties showed any marked resistance to the disease.

A gram disease caused by *Rhizoctonia bataticola* is recorded from CENTRAL PROVINCES.

Piper betle—The study of ***pan*** disease was continued at PUSA. As in previous years, treatment with 1 : 1,400 Kerol gave good results in controlling *Rhizoctonia* and *Sclerotium* diseases, and Phenyl (1 : 600 to 1 : 1,000) was also found satisfactory.

In BENGAL also 1 : 600 Kerol applied from September gave adequate control of these fungi, whilst one per cent. Bordeaux mixture applied monthly from May to October checked attack by *Phytophthora.*

In Central Provinces an anthracnose disease was observed. Both this and *Phytophthora* were controlled by spraying and soil treatment with Bordeaux.

Mildew (*Oidium* sp.) was reported in Burma and in Mysore, and was controlled in both places by sulphur treatment.

Groundnut. *Rhizoctonia* disease was observed in Bengal, especially on the varieties " U. S. improved " and " Spanish new ".

In Central Provinces the *tikka* disease caused by *Cercospora* spp. was studied. Spraying with Bordeaux and Bouisol proved ~~effective, and of~~ the varieties tested " Falcon " was the most resistant.

Chillies. Leaf-curl in Central Provinces was attributable to three causes—mites, virus, and powdery mildew. The last, *Oidiopsis taurica*, was effectively controlled by sulphur dusting or by spraying with Bordeaux.

Die-back (*Vermicularia*) occurred in several areas in Bengal.

Coconut. Diseases of the coconut palm have been investigated in Travancore. Leaf-rot is kept under control by cutting out affected material and painting the wound with Bordeaux paste, and by improving cultural conditions. Leaf-blights are caused by weakly parasitic fungi, and yield to proper cultivation and manuring. Stem-bleeding disease and bud-rot have not assumed serious proportions. Work has been chiefly concentrated on root disease ; the cause of this is still unknown but it appears to be associated with malnutrition.

Leaf-disease is reported as serious in Cochin and requires fuller investigation.

Arecanut. *Mahali* disease has been a source of considerable loss in Travancore. Large-scale demonstrations were given of the efficacy of spraying with Bordeaux mixture. Wilt disease was reported from some districts ; as with the coconut disease, cultivation and manuring are the remedies indicated.

In Cochin State *mahali* disease was also widespread, and spraying operations were carried out.

In MYSORE also *Koleroga* showed some spread, and propaganda work to encourage spraying was continued. As an emulsifier for spray mixtures, 0·25 per cent. groundnut oil is both cheap and satisfactory.

In BURMA the life-history of *Ganoderma lucidum*, the cause of stem-bleeding disease, was studied. Infection occurs most commonly through the roots.

Bud-rot, bleeding disease, and collar swelling occurred sporadically in ASSAM. Several organisms have been isolated from tissues affected by collar-rot, but inoculation of these into healthy palms has so far given negative results.

Tea. The Mycologist to the Indian Tea Association at Tocklai, ASSAM, reports that black rot has been widespread but can be controlled by spraying. Treatment of pruning cuts with bitumen paint is recommended to prevent attack by the newly described but abundant species *Glomerella major*. The effect of soil conditions on the incidence of brown blight (*Glomerella cingulata*) has been investigated. Similar experiments have also been carried out by the United Planters' Association of Southern India, in addition to a detailed study of various leaf, stem, and root-diseases.

Coffee. Leaf-rust, and damage of fruits and shoots by *Corticium salmonicolor* was recorded from CENTRAL PROVINCES.

In MYSORE the investigation of black rot was continued. Leaf-fall due to a species of *Colletotrichum* caused serious loss, and another new disease noted, appears to be allied to the "cobweb disease" occurring in Java. Biological control of green bug by a fungal parasite is giving very promising results.

Fruit trees. Diseases of citrus have been studied in the PUNJAB. One of the major diseases is withertip, and an intensive study has been made of the causal organism, *Colletotrichum gloeosporioides*. Cholorosis is amenable to treatment with 0·0001 per cent. ferrous sulphate. The saprophytic moulds causing sooty incrustations have also been investigated. For spraying, Bordeaux oil emulsion, Bordeaux with rosin, and Bordeaux-rosin, with nicotine sulphate have given excellent results. In the CENTRAL PROVINCES spraying with Bordeaux was used successfully against bacterial canker of citrus, and brown rot. Mottle leaf appears to be a deficiency disease, and was checked by the application of zinc sulphate twice a year. Gummosis of citrus was investigated in Bombay.

In BURMA considerable attention was paid to storage rots of mangoes, mangosteens, oranges, and limes. None of the chemical treatments tried was satisfactory.

Leaf spot of lime and grape fruit was widespread in ASSAM, and is only partially checked by spraying.

A soft rot of apples prevalent in the markets of UNITED PROVINCES was found to be caused by *Aspergillus niger*; preventive treatment consists of careful handling of the fruit to avoid bruises. *Colletotrichum psidii* was reported on guava fruits.

From the PUNJAB comes a report of *Fusicladium dendriticum*, found on apples at Lahore and in KASHMIR. This is the conidial stage of *Venturia inequalis*, which is a serious disease of apples in some countries. New fungal diseases of pomegranate and of apple have been recorded, due to *Amphichaeta punicae* and *Oothecium indicum* respectively.

Miscellaneous. The work on pigeon-pea wilt at PUSA has been published as Scientific Monograph No. 7 of the Imperial Council of Agricultural Research. Manuring with super-phosphate and with cattle manure was found to increase the incidence of wilt, whereas green manure caused a definite decrease. Of the varieties tried, Type 80 was found to possess the most marked resistance. The organism causing leaf spot of pigeon-pea has been investigated and described as a new species of *Cercospora*, *C. indica*. An intensive study has also been made of the *Cercospora* parasitic on *Dolichos lablab*. A seedling blight of cinchona has been shown to be due to a strain on *Phytophthora palmivora*.

Wilt of sunn-hemp has been studied at Pusa, and is due to *Fusarium vasinfectum*. The sunn-hemp strain was capable of infecting pigeon-pea, but the *Fusarium* from cotton and sesamum was a different physiologic strain. Results obtained in BOMBAY, on the other hand, do not support the identity of the sunn-hemp and pigeon-pea organisms.

Phyllody of sesamum is reported from BURMA and PUSA; at Pusa it was found to be transmissible by grafting and is therefore regarded as probably of virus origin.

Powdery mildew of peas has been under study in BOMBAY, and found to perennate as dormant mycelium in diseased seed. It can be controlled by sulphur treatment.

An *Alternaria* blight of linseed caused appreciable loss in the UNITED PROVINCES. The use of late varieties and well drained fields are suggested as control measures.

A valuable list of the fungi of BOMBAY has been published during the period under review.

At the Indian Science Congress held in Calcutta in 1935, the Presidential address to the Section of Botany took the form of a very complete summary of past and present work in India on mycology and plant pathology. In October 1935 a Symposium on 'Disease Resistance in Plants' was held at Coimbatore, and produced a number of interesting papers.

6. Entomology—Insect Pests.

(*a*) ***Locusts.*** The LOCUST Bureau of the Imperial Council of Agricultural Research continued to receive information on locusts from all parts of India and compile and distribute locust intelligence periodically. Information in regard to the findings of locusts of the solitary phase type reported by the Locust Survey staff was also incorporated in some of the periodical communiques.

THE LOCUST RESEARCH SCHEME.

With effect from the 1st April, 1933 the detailed studies of the Bionomics of the Locust were continued at Lyalpur under the direct charge and guidance of Khan Bahadur M. Afzal Husain, M.A. (Cantab), I. A. S., Principal and Entomologist, Punjab Agricultural College (on his reversion to the Punjab Agricultural Department), and the rest of the Locust Research Scheme, including the Survey and Ecological staff, was placed under the direct charge of Rao Bahadur Y. Ramachandra Rao, M.A., as Locust Research Entomologist with headquarters at Karachi.

BIONOMICS.

The Locust Research Scheme at Lyalpur dealt with the bionomics and ecology of the Desert Locust. Special attention was paid to the effect of temperature on the various life processes of the locust. The incubation period, larval duration, pre-oviposition period, longevity of the adult at different constant temperatures have been studied. The results have been published in the *Ind. Jour. Agric. Sci.* Vol. VI, pt. 2, 1936. The effect of temperature on the colouration of crowded hopper was studied and it has been shown that the intensity of black pigmentation varies inversely with temperature. A paper on the subject appears in the *Ind. Jour. Agri. Sci.* Vol. VI, pt. 3, 1936.

Detailed experiments were conducted to determine the factors responsible for the development of the gregarious colouration in the swarming hoppers. Solitaria hoppers, when reared crowded, assume gregaria colouration and *vice versa.* Isolated solitaria hoppers, when made to undergo muscular exercise, acquire gregaria colouration. Similarly isolated solitaria hoppers when reared in an atmosphere containing an excess of carbondioxide also assume gregaria colouration.

It has been discovered by actual experiments that the eggs remain unhatched and can retain their viability for a long period if the soil is deficient in moisture, even though the temperature be favourable for incubation.

During emergence a hopper takes the path of least resistance, which normally on account of the presence of the frothy plug is towards the soil surface. The movement is not guided by a positively phototropic or negatively geotropic tendency, as has often been asserted.

A study of the alimentary canal of the Desert Locust was made by a research student.

LOCUST SURVEY WORK.

In view of the experience gathered during the preliminary extensive surveys carried out in 1931 and 1932 in various parts of Sind, Baluchistan, Rajputana, South-West Punjab and the Western

India States, it was decided to restrict the survey work to the areas where locusts of the non-gregarious type had largely been noted to be present during the extensive surveys. Accordingly, during 1933 and 1934, intensive surveys were carried out at different parts of the year in such areas by staff stationed at different centres in Sind, Baluchistan and Rajputana. In Mekran, two new outposts were opened, *viz.* Gwadar and Turbat, under the charge of the Assistant Entomologist, Pasni. In Sind and Rajputana area, two survey circles each in charge of an Assistant were established; (1) for northern areas, including Dera Ghazi Khan, Bahawalpur, Jaisalmer and Bikaner with headquarters at Khanpur (Bhawalpur State), and (2) for the southern areas, including Sind, South Marwar and South Jaisalmer and Western India States, with headquarters at Mirpurkhas. In 1934, it was found advisable to open in the Indian Desert areas some outposts, where intensive locust surveys could be made throughout the year and continuous meteorological observations in regard to the climatic conditions of the desert could be recorded. Accordingly two locust outposts were opened at (1) Chachro in the Thar-Parkar District in May 1934, and (2) at Sardar Shahr in the Bikaner area in July 1934, and recently two more, *viz.* (3) at Barmer in South Marwar in April 1935 and (4) at Nokh in East Jaisalmar in May, 1935. Observations made at these stations, it may be mentioned, have since been found to be of great value.

Since April 1935, the areas under locust survey have been further restricted, as it was found that very few locusts were noticeable except in the desert portions of Sind, Baluchistan and Rajputana.

ECOLOGICAL WORK.

Ecological studies of the solitary phase of the locust were in progress in its natural breeding grounds along the Mekran coast at Pasni (as a centre typical for the winter-rainfall areas) and also at Ambagh on the Lasbela coast (as typical of the summer rain areas).

In addition to making detailed records of various meteorological data, close observations were made at these stations on the life-history and habits of the solitary phase locust in its natural habitat during the different parts of the year and on its response to changes in the climatic conditions.

It has been found that the locust is very sensitive to changes in its environment, such as temperature, air-humidity, vegetation, etc., but the most important factor in its life-economy is, perhaps, seasonal rainfall. Breeding occurs only when good precipitation brings about the required degree of wetness in the sandy soil. This is well-illustrated by the experience of the last three years at Pasni, Ambagh and elsewhere. At Pasni, there were no winter rains in 1931-32 and there was no breeding during the spring months of 1932, but with the occurrence of good summer rainfall in July 1932 locusts bred in summer. In 1933, there were heavy rains in the spring months, which were followed by extensive breeding. There was, thereafter, a failure of rains in the summer of 1933 and in both the winter and summer of 1934—a continuous draught of about eighteen months' duration, during which breeding was completely absent. Heavy rainfall occurred from the middle of December, 1934 to the middle of February, 1935 in the wake of which good breeding was noticeable. Somewhat similar experience was recorded at Ambagh and in the Rajputana areas, breeding being noticeable only after the requisite rainfall.

In the course of intensive surveys made at the different locust research stations and outposts during the last three years, it was noticed that locusts had evinced a definite tendency, sooner or later, to disappear wholly or partly from areas where they had bred and multiplied in numbers. In the winter-rainfall areas, a gradual diminution in numbers was noticeable after May, while in the summer breeding areas, such as at Ambagh and Chachro, locusts were either entirely absent between December and April, or present only in very small numbers, but from May onwards they were found reappearing in gradually increasing numbers. After the close of the summer breeding season, the locust population usually decreased gradually till very few could be noticed during December-January. A close examination of large numbers of bushes in many places during the months of January, February and March did not disclose the presence of any over-wintered locusts, so that such a disappearance could not be ascribed to a phenomenon of hibernation. The occurrence of a widespread incursion of locusts during the summer of 1935 has demonstrated the possibility of the migration of locust individuals over large distances, as distinguished from the migration of large swarms. It is surmised, therefore, that the seasonal disappearance of locusts of the solitary type on the different breeding grounds is due to their migration from one rainfall zone to another with the change of the seasons. Positive evidence of the capability of locusts of the solitary or non-gregarious type to migrate long distances has been recently obtained by the discovery of the appearance of a recently developed generation of locusts in regions where recent breeding had certainly not occurred.

In May-June 1935, certain instances of damage to cultivation by bands of gregarious hoppers were reported in Mekran, but as they were, unfortunately, brought to the notice of the staff at quite a late stage of the attack, a proper investigation could not be made. There is little doubt, however, that these represent cases of the incipient outbreaks of the locust, being probably instances of the actual transformation of phase *solitaria* into phase *gregaria*. Since the entrance of no actual swarms had been noticed prior to these cases of hopper-attack, it is presumed that these incipient outbreaks had been brought about by the migration of locusts of the solitary non-gregarious type from the coastal belt, and their consequent concentrated egg-laying in suitable patches of sand in the neighbourhood of cultivation.

Similar cases of incipient outbreaks are on record in 1923 and 1926—years when swarms were not known to be present; and this would indicate the importance of an early detection of such outbreak centres and their prompt and efficient handling, if the nipping of future outbreaks of locust infestations in the bud is to be our aim.

LOCUST MOVEMENTS.

Many small swarms were reported between October 1933 and February 1934, in the Rajputana area and in the districts adjoining, such as South Punjab, Bahawalpore, Muttra, Indore and Western India States, but in none of these cases were specimens secured. Since, however, there was prolonged rainfall in the Bikaner State and the areas round about, it may be presumed that locusts had bred extensively and had probably gone through two successive generations during the monsoon period, and had thus given rise to the swarms reported.

In September, 1934, a few swarms were reported from the Malakand Agency in the North-west Frontier, and presumably the species concerned is the Moroccan Locust (*Dociostaurus maroccanus*), known to be active in the northern parts of Afghanistan.

STUDY OF OLD RECORDS.

The study and compilation of all available old records was continued. Special attention was paid to the study of the information on locusts available in the Season and Crop Reports published in the Sind Official Gazette for years from 1873 to 1933, and also of similar data extracted from the Season and Crop Reports of the Punjab Supplementary Gazette for years from 1869 to 1925. Similar information available in the Bombay Government Gazette was also extracted for years 1869 to 1933.

As far as possible, all the data have been arranged chronologically, and locust movements are being mapped month by month.

In regard to the data extracted from the Bombay Government Gazette, it was evident that in some cases, references to locusts in the season reports concerned the Desert Locust and in others, the Bombay Locust (*Patanga succincta*). Though in a few cases it was difficult to decide which species had been referred to, the data have been, on the whole, clearly differentiated in most cases.

It is evident that, like the Desert Locust, the Bombay Locust also has had its periods of increase and decline which however appear to depend on a somewhat different set of factors controlling its multiplication and development. The Bombay Locust goes through only one generation in the year, and the breeding commences only after the fall of the first monsoon showers. The building up of its population is, therefore, a somewhat slower process and an increase in numbers can only be brought about by a succession of favourable seasons.

From the data available in the Season and Crop Reports, the Bombay Locust has had two great cycles of multiplication since 1873. Although swarms occurred during the years 1873-75, and 1877-79, the first great outbreak occurred during the years 1881-84. The next cycle began about 1897, but the actual outbreak lasted from 1901 to 1908, the peak being reached during the years 1902-04. Since the year 1908, although a few swarms have been reported in certain years in some districts, there has been no general outbreak. It should be interesting to investigate fully into the causes underlying the quiescence of this species since 1908.

THIRD INTERNATIONAL LOCUST CONFERENCE, LONDON.

The Third International Locust Conference met at London in response to invitations issued by the British Government to countries interested in Locust Research, and was represented by thirteen countries and attended by fifty delegates and advisors. India was represented by the Locust Research Entomologist to the Imperial Council of Agricultural Research, Karachi. Various resolutions were adopted at the Conference with reference to the different aspects of locust research, and general recommendations were made in regard to the future programmes of work in the different countries affected. The discussions that took place at the Conference were of great value in focussing the experience of workers in different countries and in bringing about a clarification of ideas in regard to various vaguely-understood points of locust research.

(*b*) **Other insect pests.—Sugarcane.** Detailed observations were made at Pusa on the bionomics and relative incidence of borers and other pests of sugarcane. At the harvest time of 1933-34 and 1934-35 crops about 16,000 and 14,000 canes respectively were examined and the extent of percentage damage was as follows :—

Year.	Top-borer.	Stem borers.	Root borers.	Termites.
1933-34	11·6 to 35·4	2·3 to 8·0	3·2 to 11·6	1·5 to 7·8
1934-35	55·4 to 82·1	15·4 to 61·0	45·2 to 43·1	1·1 to 9·6

It will be seen that the damage by borers was much more severe during 1934-35 than in 1933-34 and that the top shoot-borer, *Scirpophaga nivella* was by far the most serious pest. This borer hibernated in canes in the larval stage up to the third week of February, when pupation commenced. The first moths emerged about the end of February.

In view of the variable results which have been obtained so far in India regarding the incidence of various borers in different varieties of cane, a randomized plot with five varieties, *viz.*, Co. 210, Co. 213, Co. 299, Co. 313 and Co. 331, was laid in February 1935, covering about four acres of land. About 4,000 canes of each variety are being examined every month and the final readings will be taken at the time of the next harvest (February 1936) and reported in due course.

The eggs of root-borer, *Emmalocera depressella* were found heavily parasitized (up to forty per cent.) at Pusa by *Trichogramma minutum* in June 1935. One to three parasites developed from a single host egg. The parasite completed its life-cycle in about seven days in the laboratory in summer. The larvae of the root-borer were parasitized (three to four per cent.) by a Braconid *Glyptomorpha deesae*. The stem-borer *Argyria sticticraspis* was found parasitized at Pusa by *Apantales flavipes* practically throughout the season. Forty to eighty parasites were bred from one host egg in the laboratory. A careful study of the bionomics of this important parasite has been made.

Studies on the seasonal distribution of *Pyrilla* spp. at PUSA showed that the insects were very rare up to the end of May. This was obviously due to excessive dry heat as oviposition and breeding commenced on a large scale after a few showers of rain in June. In

August the eggs of this pest were found parasitized upto 52·5 to 68·7 per cent. by *Tetrasticus pyrillæ.* A month later parasitization was as high as 94·9 per cent. In the end of October *Pyrilla* nymphs were parasitized by *Dryinus pyrillæ* and *Chlorodrynus pallidus.*

In the PUNJAB, particularly in the South-eastern districts, the top-borer did a great deal of damage to the sugarcane crop. The loss thus caused was estimated at about rupees three lakhs in a single Tahsil of Rohtak district. The attack ranged from twenty-five per cent. in Co. 285 to eighty-five per cent. in Co. 213. *Pyrilla* was also serious on softer varieties of sugarcane. Harder and narrow leaf varieties like Co. 205 and 285 were found to be resistant to the attack of this pest. A hopper dozer machine for the collection of *Pyrilla* adults was devised and has given promising results.

Studies on the black beetle *Alissonotum impressicole* of sugarcane were continued in BURMA. Owing to a greater portion of the sugarcane-growing area being under the control of the Burma Sugar Company it was possible to enforce the systematic collection of beetles under the guidance of a Cane Pest Board organised for this purpose. It has been proved that if fields are ploughed up and left fallow for a full season, cane can be grown in them without fear of any serious damage by this pest. Two more beetles, *Heteronychus lioderes* and *Alissonotum crassum* were found to be on the increase in this area though not yet serious. A new pest which affected about 1,000 acres of sugarcane in Burma was the woolly aphis, *Oregma lanigera.* It caused decrease in the sucrose-contents of canes.

In ASSAM, the root-borer was found to be rare, the top shoot-borer predominated during the early stage of the crop, while the stem borers, *Argyria sticticraspis* and *Diatraea venosata,* were more common in mature canes. The percentage of borer attack was calculated periodically. It was 5·0—15 per cent. up to January but rose to 60·1 per cent. in February and 16·8 per cent. in March. The removal of affected canes and burning of stubbles were found useful.

In MYSORE, the top and stem-borers caused the maximum amount of damage, more particularly to canes planted in

February—April. Immersing the setts harbouring borers in water for forty-eight hours before planting was found to very effective in keeping down the attack to the next crop. The egg parasite *Trichogramma minutum* was bred in large numbers in the laboratory, and frequently liberated in the cane-fields. From an initial natural parasitization of two per cent., it is stated to have risen to fifty per cent. in three weeks as a result of the introductions. Results have been so far encouraging, and it is contemplated to undertake large-scale trials.

Cotton. A scheme financed by the Indian Central Cotton Committee for research on the Spotted and Pink-Bollworms of cotton was in progress in the PUNJAB. Intensive ecological studies on Pink-Bollworm ~~have~~ shown that its peculiar distribution in the Punjab is mainly due to different conditions of temperature and humidity in the various parts of the province. Moths exposed to a temperature above 33°C., during their pupal stage do not produce many functional sperms. Again where the humidity is low, the number of eggs laid by the moths is very small. Thus in the western Punjab where the mean daily temperature is about 33°C. and the humidity is low, the conditions are not favourable for the multiplication of this pest.

Unlike Pink-Bollworm, the Spotted Bollworm is most severe in the canal colonies and in the western Punjab. It has been found that for the four months when cotton is not in the field this pest lives on certain malvaceous weeds and on young shoots of ratoon cotton. This suggests that, if the fields are completely cleared of the last year's stumps, there will be very little chance for the pest to infest the next year's crop.

The cotton White Fly, which is another serious pest of cotton in the Punjab, has also been intensively studied in some parts of the Province. The most active period of its development is from May to September after which it migrates to alternative food plants such as turnips, potatoes, cauliflour, etc. From March to May it attacks cultivated cucurbits and ratoon cotton, whence it spreads to the new cotton corp. A heavy infestation by this pest undoubtldly affects the yield adversely, but this pest is not considered to be responsible for the frequent failures of cotton crops in the past. Experiments have clearly shown that spraying with rosin compound is a most effective means of controlling this pest, the mortality with this spray being eighty-three per cent. The cost of spraying on a large scale amounted to Rs. 1-8 per acre.

A sudden and severe outbreak of the cotton leaf-roller (*Sylepta derogata*) appeared in South-western Punjab. With the co-operation of the Forest Department, a thorough clean-up of various malvaceous weeds and ratoon cottons was carried out with useful results.

In the UNITED PROVINCES Pink-Bollworm was rather serious in 1933 owing to abnormal rains. Results of sun-heating of the seed were therefore not as spectacular as in previous years. Even under such unfavourable conditions it is estimated that the direct benefit to cotton-growers of some 46,000 acres amounted to about five lakhs of rupees; thus the preventible loss on this basis in the whole of the province totals over eighty lakhs of rupees.

The studies on the cotton stem-weevil (*Pempheres affinis*) were continued in the MADRAS PRESIDENCY. A number of varieties of cotton were tested for their susceptibility to the weevil. Plants considered to be tolerant during the past two seasons were also found to be equally susceptible to the insect attack during 1933-34. It has been observed that the borer continues to emerge from the pulled out cotton stalks for a period of two months, suggesting thereby that one way of combating the pest is to have a close period of not less than three months between the old and the succeeding crops. It was also found that drying the pulled-out stems in the sun for a week or ten days proved fatal to all the stages of the insect. In 1934-35 the loss due to stem-weevil was twenty per cent. by way of mortality and thirty per cent. more by crop-yield. Amongst several varieties tried, Bombus was found most resistant, Buri, Gadag and Durango coming next.

The work on the Spotted Bollworms in the MADRAS PRESIDENCY was continued at Coimbatore.

Of the local varieties, the Uppam seems to be the least attacked, while the Karunganni suffers the most.

At Surat in the BOMBAY PRESIDENCY the Bollworm clean-up scheme was given a further trial on a large scale. In spite of the unusually severe winter during 1933-34, the yield obtained in the clean-up area exceeded by twenty-five to thirty per cent. of the yield obtained outside this area in the previous season when record yields were obtained. With the help of a grant from the Indian Central Cotton Committee efforts were made to popularise the cotton-puller, a cheap and effective implement to pull out cotton stalks after the crop is over.

In BURMA the cotton stem-weevil *Pempheres affinis* was recorded for the first time in 1934. *Hibiscus abelmoschus*, previously recorded as a successful trap-crop for Red cotton bugs, failed as it was not able to fruit and flower before cotton.

Paddy. The paddy army worm, *Spodoptera mauritia*, the stem-borer *Schoenobius incertellus* and the rice beetle *Rhizopertha dominica* were under study in the MADRAS PRESIDENCY. In the case of army worm, irrigation and kerosinizing the irrigation water were found effective against the caterpillars in the nurseries. Freshly hatched caterpillars were also successfully destroyed by dusting with calcium arsenate and lime in the ratio of 1 : 8. The damage by the paddy stem-borer was appreciably reduced if the plant growth was accelerated by the use of ammonium sulphate as a top-dressing.

In BENGAL *Schoenobius bipunctifer*, *Spodoptera mauritia* and *Cirphis unipuncta* were found damaging paddy. The stem-borer was usually serious in water-logged transplanted plots and was controlled by letting the excess water out. In the Chittagong district rice Jassid was quite serious ; it was successfully controlled by bagging.

In ASSAM *Spodoptera mauritia* appeared in an epidemic form after the floods. Flooding the fields with water and then netting the caterpillars with a fine mesh net and trapping the moths in the Andres maire trap was found useful. The stem-borer caused considerable damage to the late-sown crops. It was controlled by clean cultivation and burning of stubbles after the harvest. Rice case-worm *Nymphula depunctalis* was checked by netting and floating larval cases. Rice-bug, *Leptocorisa varicornis*, was controlled by bagging and using light-traps.

In the CENTRAL PROVINCES the Gangai pest (*Pachydiplosis oryzae*) damaged paddy in September 1933. Both the eggs and pupae of the pest were found parasitized. In the same year this pest caused serious damage to paddy crop in MYSORE, appearing there after about thirty years.

Spodoptera mauritia appeared in large swarms in several parts of the TRAVANCORE STATE. Flooding and dusting the crop with Paris Green and lime were tried with success. *Schoenobius bipunctifer* was successfully controlled by weeding out infected seedlings from the nurseries.

Fruits. At PUSA *Dichochrocis punctiferalis* and *Virachola isocrates* bored guava and some other fruits and caused considerable damage. Mango plants were attacked by *Amblyrrhinus poricollis, Monophlebus* spp., *Idiocerus* spp. and *Pulvinaria psidii.* The latter two were controlled by spraying with rosin compound when the plants were not in flowers. *Nodostoma subcostata*, nibbled the skin of plantain fruits, *Papilio demoleus* damaged citrus leaves, while fruit flies caused damage to various cucurbit fruits.

Investigations by the staff of the Imperial Entomologist on the insect pest of fruit trees in BALUCHISTAN were continued. On apples, pears and quinces a large number of larvae and pupae of the notorious Codling moth, *Laspeyresia pomonella,* were discovered for the first time, along with another Eucosmid caterpillar *Spilonota ocellana.* The life-history of the former has been worked out. Lead arsenic powder at a dose of 1 lb. in 50 gallons or lead arsenate paste at double this dose has been recommended against the pest. The " Quetta borer ", *Aeolesthes sarta,* which was formerly known to attack only poplar trees along the roadside, was found attacking the stems of several fruit trees, *e.g.*, apple, peach and the larvæ of *Cacoecia pomivora* were severely infesting apple foliage.

In the PUNJAB studies on the seasonal history and control of San Jose Scale and the woolly aphis were made at Kulu. In the case of woolly aphis, use of nicotine sulphate against the aerial forms and treatment of roots with carbon bisulphide against the subterraneous forms gave very successful results. Spraying against the scale covered a wide field of operations; about 20,000 fruit trees being sprayed in the Simla hill and Kulu valley.

The mango mealy bug, *Monophlebus stebbingi*, was very abundant and considerably reduced the mango crop in the UNITED PROVINCES. Sticky bands were found useful, but they were often spoiled by dogs. Deterrent mixtures are being tried.

The mango weevil, *Cryptorhynchus gravis*, was pretty serious on mango fruits at the Dacca Farm in BENGAL. The pest was kept down by the collection and destruction of affected fruits.

In ASSAM, the longicorn stem-borer *Monohamus versteegi* did considerable damage to orange trees. It has only one generation in the year. The adults emerge in April and the eggs are laid in July. The grubs were easily killed by piercing a wire in the borer holes.

The moths *Othreis* spp. and *Achaea* spp. caused serious damage to orange fruits in the CENTRAL PROVINCES. Collection and destruction of larvae from different food plants was found useful. Carbon bisulphide was found very effective for controlling the borer *Indarbela quadrinotata* which is a serious pest of orange and guava trees in this province.

Large-scale spraying operations were carried out against mango hoppers (*Idiocerus* spp.) in MYSORE with Hongey oil soap.

Tea. The work on insect pests of tea was in progress in the Tea Scientific Department of the United Planters' Association of Southern India. Studies on the life-history and biological control of *Helopeltis theivora* were carried out in the TRAVANCORE STATE. The rate of development of the South Indian form is much slower than that of the North Indian form. The former takes thirty-one to thirty-seven days to complete one generation in the most favourable month of July against only 15 days taken by the latter. In the field, the males were invariably more common than the female. Eggs are generally laid in the topmost leaves, in a completely 'shut up' condition, so that the complete removal of the tops of such bushes reduces the pest. Two parasites, *viz.*, *Agamermis paradecaudata* and *Euphorias helopeltidis*, have been investigated for biological control of the pest, the results are not encouraging.

With regard to cultural methods, dry weather pruning has been found to be very useful. Eleven different alternative host plants have been discovered which provide suitable food supply during dry weather when the tea crop itself does not provide suitable food to the pest.

Damage done by *Tortricids* was very low, obviously due to the prevalence of exceptionally dry weather. *Gracilaria theivora*, the common tea leaf-roller, though less in number, seemed to be very widely distributed.

Pyralid caterpillars of a new gennus and species *Erobaenis saturata* were also collected on tea in TRAVANCORE. *Anomala gemmula* and *Mimela xanthorhina*, the green beetles, caused serious damage to tea bushes by denuding them of all leaves.

About one dozen species of Nettle grubs have been discovered of which the most common ones are :—*Thosea cervina*, *Natada nararia* and *Spatulifimbria castanciceps*. It is noteworthy that the latter two were hitherto believed to be confined to Ceylon. Another species *S. grisea* has been recorded for the first time from South India. Its life-history and habits have been investigated in detail.

Coffee. In MYSORE a treatment of young coffee crops with a ten per cent. tar distillate emulsion reduced the attack of coffee borer *Xylotrechus quadripes* by fifty per cent. Further experiments are in progress. A small beetle borer, *Xyleborus morastatti*, was found breeding in large numbers on young branches of *Robusta* and *Arabica* coffee. Its life-history is being investigated.

Tobacco. The virus ' Leaf curl ' disease of tobacco is becoming very serious in NORTH BIHAR. In order to discover the probable insect vectors of the disease, the entire insect fauna of tobacco crop has been investigated at PUSA. A long series of inoculation experiments with various suspected insects are in progress.

Linseed. A new species of Cecidomyid fly, *viz.*, *Dasyneura lini*, has been discovered to be a pest of linseed in NORTH BIHAR. Its life-history and biology has been studied at Pusa where the damage by this pest in 1933 was as much as fifty per cent. The eggs are laid on the flower buds and the young larvae bore the base of the young flowers. Such flowers fail to open out completely and do not bear fruit. With the contemplated extension of linseed cultivation in India, it is feared that this pest may assume an important status.

Vegetables. There was a serious attack of *Agrotis ypsilon* on peas at PUSA. The pest was successfully controlled by handpicking, trenching and poison baits. Moreover, the flooding of the field brought out numerous caterpillars which were preyed upon by birds.

At Poona in the BOMBAY PRESIDENCY, three species of aphids *Siphocoryne indobrassicae, Brevicoryne brassicae* and *Myzus persicae* were intensively investigated. The life-histories of all the three species have been found to be almost similar in essential points. A freshly laid young one matures in about four days and the adult lives for about two months. Spraying with Black leaf 40 at 1 : 800 was very effective. Two species of *Thrips, Scirtothrips dorsalis* and *Thrips tabaci*, were found breeding on chillies and onions throughout the year. The life-cycle took seventeen to eighteen days in case of both species.

The brinjal fruit and root-borers were under investigation in the PUNJAB.

The large brown cricket and mole cricket seriously damaged winter vegetables at Jorhat Farm in ASSAM. They were controlled by light traps and flooding the holes of insects with phenyl water. The cut worms (*Agrotis ypsilon*) were also serious on potatoes and other vegetables in this province. Their damage was checked by hand-picking. *Aulacophora abdominalis* and *Epilachna* beetles were controlled by spraying with lead arsenate in Assam as well as in MYSORE.

Stored grain pests :—Ecological studies on the life-history of common grain weevil *Calandra oryzae* have been started at PUSA. Preliminary observations show that below sixty per cent. humidity at room temperature the oviposition is very limited and the percentage hatching is seriously affected.

In BURMA, the pulse beetles *Bruchus chinensis, B. analis* and *B. phaseoli* were intensively studied with special reference to their food habits. After extensive trials pulses have been listed according to their susceptibility to the beetle attack. A simple method of separating attacked *Dolichos lablab* seeds from the unattacked ones has been devised, which consists of soaking them in water; the unsound seeds when soaked swell up and can be easily picked out.

Miscellaneous. In BOMBAY and CENTRAL PROVINCES the cochineal insect, *Dactylopius tomentosus*, has been extensively and successfully used for controlling Prickly Pear bushes.

Insecticidal values of the roots of *Mundulea suberosa* and *Randia dumetorum* were investigated in MYSORE. A ten per cent. water-extract of the root of latter produced eighty per cent. mortality in the green scale *Coccus viridis*.

7. Useful Insects.

Laccifer lacca Kerr (***Tachardia lacca*** Kerr). Research at the Indian Lac Research Institute has resulted in the following important advances and discoveries in the entomology and chemistry of Lac and Shellac during the years 1933-35.

A study of the myology of the adult female lac insect *Laccifer lacca* Kerr and of the mechanics of oviposition has led to the development of a simple method of forecasting the date of emergence of the lac larvae, facilitating the avoidance of premature or late cutting of brood-lac, both of which are harmful.

It has been shown that *L. lacca* females can reproduce parthenogenetically for as many as twelve successive asexually produced generations without detriment to their fertility or to the sex ratio and resin production of their progeny. The factors governing the percentages of males and females in the progeny of the lac female are under investigation.

An investigation of the parasites and predator enemies of the lac insect has led to the conclusion that the former are only of minor importance.

Eight *Chalcidoid* parasites of *L. lacca* commonly occur. The average percentage parasitism over a period of seven years was found to be of 4·8 per cent. with an average maximum of only 9·9 per cent. Hyperparasites were found to be of little value as controlling agents, the average percentage hyperparasitism over a period of five years was 3·6 per cent. with an average maximum of only

10·1 per cent. The hyperparasites concerned are not to be encouraged as they are in addition primary parasites of *L. lacca.*

Eublemma amabilis Moore and *Holcocera pulverea* Meyr are the major predator enemies of lac, and are estimated as damaging between thirty to forty per cent. of the lac cells. Previous conclusions as regards the former predator have been confirmed. *Holcocera pulverea* passes through five generations in the year and does more damage to *Katki* and *Aghani* lac than to *Baisakhi* and *Jethwi,* the predator is not so serious a pest as *E. amabilis* to the lac crops but is more serious in stored lac.

Artificial controls have been devised which are effective alike against parasite and predator enemies of the lac insect. Since lac cultivation is almost entirely in the hands of ryots of little means and limited intelligence, only methods of extreme simplicity not entailing any expenditure are recommended for general use. These consist largely in control by cultural practice.

Research on the natural enemies of predators enemies of lac has led to the conclusion that of the many insects investigated two are of major importance and bring the biological control of these important enemies into the range of possibility. *Microbracon greeni* Ashm is an indigenous parasite of *E. amabilis,* the average percentage parasitism being about seven per cent. to ten per cent. with a maximum of thirty per cent. to forty per cent. *M. greeni* can be easily bred in the laboratory and it is believed that purposeful introductions of artificially bred parasites into *E. amabilis* affected areas would be beneficial at critical times

Microbracon hebetor discovered for the first time in North India in 1935, though not a regular parasite of lac predators, has been successfully bred as a parasite of both *E. amabilis* and *H. pulverea* at Namkum. The main hosts of *M. hebetor* are all pests of more or less economic importance and the *Braconid* is considered to be a potentially ideal parasite for the acclimatisation to lac predators and introduction into lac-growing areas.

The most important pests of lac host trees are Termites and the *Coccid Aspidiotus orientalis,* the former have been held in check by systematic fumigation of Termitaria, the latter by pruning and spraying with lime sulphur. Recent research has shown that *A. orientalis* is becoming immune to lime-sulphur spray and the efficacy of a low-boiling completely refined petroleum distillate has been tried. It is yielding promising results.

During 1935 a scheme has been initiated whereby *kamdars* selected and trained at the Institute will be sent out into important lac-growing areas to demonstrate the practical results of the Institute's work to the cultivator.

A study of pruning methods has shown that the ryot's method of pruning *kusum* (*Schleichera trijuga*) is not only wasteful but actually harmful to the tree. Trees after pruning or cropping in this way have to be rested for two years or more before they can be infected or reinfected. A method of light pruning has been devised, whereby trees can be utilised for an infection one year later and the tree itself not reduced in frame thereby.

A study of the water-resistance of shellac varnish films has resulted in the discovery that the addition of a very small optimum quantity of certain chemicals, *e.g.*, urea or thiourea, can impart considerable improvement in this property.

These same chemicals, *i.e.*, urea and thiourea and others of the class known as 'shellac accelerators' can impart improvement to other properties of shellac, *e.g.*, 'heat-resistance'. Advantage has been taken of this in the development of shellac-moulded articles which are 'non-warping' under warm conditions.

'Kiri' is an important bye-product of shellac manufacture. The possibility of extending the use and enhancing the value of this material has been investigated. A process has been developed for converting 'Kiri' into a moulding powder for use in the manufacture of cheap-moulded articles.

The refractive index of shellac is an important property in many ways, but there is but little accurate information in the literature concerning it. Careful determination of a large number of shellacs have been made in the Institute by an improved and accurate method. It has been established that any alleged pure country-made shellac with full wax-content which gives a refractive index outside the range 1·516 to 1·519 should be suspected of abnormality.

Shellac, which has been incorrectly stored or subjected to the action of certain chemicals, *e.g.*, vapours of hydrochloric acid or ammonia, may become insoluble in alcohol and infusible. Such shellac is of no value in commerce. The possibility of reconditioning this shellac and converting it to a useful product has been investigated and it has been shown that several practical processes are available. Of these the effect of treating the shellac in an autoclave at about 300 lbs. per square inch pressure for a short time is probably of the greatest commercial importance.

The 'bleachability' of shellac has been a subject of considerable discussion amongst consumers during the last two years. Several aspects of this property of shellac have been studied and it has been shown that the nitrogenous matter derived from the remains of the bodies of the lac insect is capable of consuming considerable quantities of 'hypochlorite liquor' during the bleaching process.

It has only been possible to touch very briefly on the more important results obtained at the Indian Lac Research Institute during the years 1933-35. A detailed account of the Institute and its work is to be found in 'Lac and the Indian Lac Research Institute' by Dorothy Norris, P. M. Glover and R. W. Aldis, price Rs. 2-8-0, obtainable from the Director.

8. Sericulture.

Due to the continued depression in the price of silk and the increasing competition from imported Chinese and Japanese silk, the Indian silk market was seriously affected. An enquiry by the Indian Tariff Board resulted in the provision of a protective tariff. The Government of India also sanctioned special grants to aid development of the silk industry. As the fundamental basis of the silk industry is the "seed" (eggs) of silkworms, the Provincial Governments and States organised specialised seed-rearing nurseries to produce disease-free layings and distributed these to the silkworm-rearers. The improvement of indigenous silkworm breeds, the introduction of superior-yielding exotic races and the creation of suitable hybrid varieties, adapted to particular tracts, are some of the items receiving the special attention of the Governments and

States concerned. The training of silkworm rearers in the production of disease-free eggs and the improvement of their rearing conditions, by demonstration and propaganda in villages, are important items in the direction of progress. Improvement in methods of reeling, grading of silk yarns, weaving of silk fabrics and marketing are also receiving due attention in most of the silk-producing tracts of India.

The Bengal Government, in the past, maintained twelve nurseries for the production of disease-free layings and seed-cocoons, but on account of financial stringency, five of the smaller nurseries were closed and the number was reduced to seven in 1933-34. The present objective is to extend the work of selected rearers who are private seed-rearing agents working under departmental supervision. Most of these rearers are passed students of Government Sericultural Schools. In 1933-34, the Government nurseries produced sixteen tons of selected seed-cocoons from disease-free layings and the selected rearers raised eighteen tons of the same strains. During 1934-35, the Government nurseries raised 14½ tons, whereas the selected rearers' output was increased to twenty-one tons. The total production was thirty-four tons and 35½ tons in 1933-34 and 1934-35 respectively. The reduction in the number of Government nurseries has temporarily restricted the total output of disease-free seed, the production being 6½ tons less than that produced in 1931-32. With the aid of the Government of India grant for the extension of selected rearers, it is expected that the department will, in a short time, be able to develop the seed production and supply the entire requirement of ninety tons of seed-cocoons per annum.

The bulk of the silk in Bengal is produced by the indigenous multivoltines (Nistari and Chotopoulu) and the univoltine (Barapolu *Bombyx Textora*) species of silkworms, but the rearing of exotic univoltines and *Eri* silkworms is on the increase.

Investigations into the manuring of mulberry lands with a view to reduce the cost of production of leaves are being carried on in each nursery. The extension of tree mulberry cultivation in Government nurseries and in the lands of rearers is making much headway.

Attempts are also being made to induce the rearers to improve their rearing houses by fitting wire-net doors and ventilators. The total number of such improved houses in the district of Malda rose to 2,443 in 1934. Similarly by 1934, the number of mulberry trees in Malda stood at 35,547 where previously no mulberry tree was grown. Similar steps have also been taken in other districts to extend the planting of mulberry trees and to improve rearing houses. The demonstration staff also undertook preventive measures whenever any outbreaks of disease occurred. In 1933-34, 422 cases of epidemic diseases were reported of which 362 were successfully checked. The corresponding numbers in 1934-35 were 321 and 311.

Agricultural loans amounting to Rs. 5,000 in 1933-34 and Rs. 9,440 in 1934-35 were granted to silkworm-rearers by the Collectors of Malda, Murshidabad and Birbhum on the recommendation of the department.

As a result of the continued trade depression and the abnormal competition from cheap foreign silk, piece-goods, spun yarns, etc., the sericulturists in MYSORE found it very hard to find an outlet for their cocoons, as the reelers and silk merchants had suffered very heavy losses. Though there was no appreciable reduction in the cost of production, the price of cocoons fell to as low as annas three per pound. As a consequence there was a further fall in the area under mulberry in the State from 36,600 acres in 1932-33 to about 33,000 acres in 1933-34.

The Government grainages in Mysore supplied 2,076,979 disease-free layings to the sericulturists and farms in the State in 1933-34 as against 1,682,836 disease-free layings supplied in 1932-33. The total output of cross-bred and pure foreign races amounted to 1,226,000 disease-free layings in 1933-34 in place of 740,278 in 1932-33.

With the object of increasing the availability of foreign race seed-cocoons and thus increase the production of cross-bred layings in Government grainages, experienced rearers within easy reach of Government farms were selected and were supplied with foreign race layings free of cost. All the cocoons produced by these people were obtained for the Government grainages. Altogether about

5,812 sericulturists obtained disease-free layings from Government farms in 1933-34.

The free supply of Mysore layings to selected rearers during the year 1933-34, amounted to 236,626 layings as against 232,379 layings during 1932-33. The seed rearers sold about 472 lakhs of seed-cocoons in 1933-34 as against 400 lakhs of seed-cocoons during 1932-33. Expressed in tons, one *kahon* (1,280 cocoons) being equivalent to one seer, the total output of seed-cocoons was thirty-three tons and twenty-seven tons respectively.

There were sixteen aided grainages, of which thirteen were active and supplied 1,384,703 disease-free layings in 1933-34 as against 1,642,565 during 1932-33. These aided grainages distributed layings to about 751 sericulturists and were granted a bonus of Rs. 3,965 on the layings produced by them. Loans amounting to Rs. 1,700 only were disbursed to ten rearers in 1933-34.

Research and experiments on the embryology of silkworms were carried on at the Laboratory attached to the Experimental Section at Channapatna. Experiments in mulberry cultivation, silkworm rearing, etc., were conducted in Mysore and Channapatna farms.

The staff on propaganda work in the important sericultural taluks constantly visited the rearing houses of sericulturists and gave technical assistance. Houses of sericulturists were disinfected free of cost to eliminate diseases of silkworms.

The Government filature produced 5,556 lbs. of silk yarns of which 4,800 lbs. were 13-15 denier silk. About 105 lbs. of silk only were sold to private parties, the major portion of the production amounting to 5,376 lbs. being sold to the Government Weaving Factory, Mysore.

In MADRAS, the silk farms at Coonoor, Hosur, Palmaner and Kollegal continued investigations on the rearing of foreign hybrid races and the Mysore race of silkworms. The yield of the hybrid races was found to be superior to that of the Mysore race. The Palmaner silk farm had five successful rearings in 1933-34 and produced, 100,910 seed-cocoons out of which 87,800 seed-cocoons were sent to Kollegal for conversion into disease-free layings and the rest converted into silk. The aided grainages at the R. C. Lace School raised 18,000 disease-free layings. The peripatetic party tested 961,588 layings in 1934-35 as against 843,000 in the previous year. The department purchased 707,250 seed-cocoons for Rs. 613-3-3 and 205,927 disease-free layings were obtained. The sale proceeds on account of these layings and pierced cocoons amounted to Rs. 739-9-2.

At the Tadaguni Farm, six rearings of pure Mysore worms and four rearings of hybrid worms were successfully undertaken during 1934-35 with 2,276 layings of seed which gave an output of 876 lbs. of cocoons. From these 36,248 disease-free layings were distributed and the balance converted into silk.

A reeling machine with four reels was made at the Government Textile Institute, Madras, and sent to Kollegal for trial. The silk reeled on this machine has been favourably received by the weavers. An improved twenty-four spindle twisting machine is being constructed as the smaller twelve-spindle Japanese twisting machine is not sufficient to meet requirements.

Manurial experiments on mulberry are being carried on in the farms at Hosur and Conoor with varying proportions of sulphate of ammonia, *pungam* cakes and farmyard manure.

In ASSAM, the sericultural nurseries at Titabar and Shillong carried on investigation on foreign univoltine races of silkworms and the local indigenous breeds of *Muga*, *Pat* and *Eri* silkworms. The station at Shillong supplied 4,528 layings and 3¼ oz. of *Pat* silk and 475 layings and 200 cocoons of *Eri* in 1933-34 and 16,481 layings and 600 seed-cocoons of *Pat* and 485 layings of *Eri* and 100 seed-cocoons of *Muga* in 1934-35.

The number of demonstrators was increased from six in 1933-34 to seven in 1934-35. There has been an increasing demand for examined seed and the demonstrators worked in the villages teaching the rearers improved methods of rearing, reeling and spinning of *Eri*, *Muga* and *Pat*.

The extension of the hill station at Shillong is obviously essential to meet the increasing demand for departmental seeds, as the temperature is favourable for rearing during March to November and no artificial heat is needed for hibernation of eggs excepting during the incubation stage.

In BURMA, the sericultural operations are centred round the nurseries at Maymyo, Mandalay and Paukkang and the Prome district of which the Maymyo sericultural station is the central nursery of the department.

In 1933-34, the total seed supply was 10,457 layings and 15,850 seed-cocoons as against 21,118 layings and 11,798 seed-cocoons in 1934-35.

9. Apiculture.

A large number of enquiries on the methods of keeping bees received from various parts of India by the Imperial Entomologist, Pusa, indicate that bee-keeping is becoming very popular in this country. The Imperial Entomologist, PUSA, supplied standard size hives, foundation sheets and other appliances to numerous correspondents. In MADRAS, the life-history and some other features in the biology of the Indian bee, *Apis indica* were under investigation. The study of the influence of climatic conditions on the biology and breeding of bees has been started in the PUNJAB. Apiaries are also being maintained for demonstration purposes at Shillong and Jorhat in ASSAM and at Bangalore in MYSORE.

Schemes for research on bee-keeping were submitted by the BOMBAY GOVERNMENT and the BARODA STATE for grants from the Imperial Council of Agricultural Research and these were dealt with by a Special Committee appointed by the Advisory Board of the Council. It was, however, considered that this could be satisfactorily dealt with only by an *ad hoc* Committee composed of specialists in bee-keeping. Such a committee was accordingly convened and eventually decided that the Imperial Council of Agricultural Research should select through the Public Service Commission a person with suitable experience and qualification and send him abroad for advanced training in bee-keeping, after which he should be employed to advise Provincial Governments on bee-keeping. This Committee considered that bee-keeping was likely to become of increased importance owing to the Village

Uplift Movement. After obtaining information as to what had been done in the past and the scope for development in India, it was decided that it would be necessary to draw up a comprehensive scheme for developing bee-keeping in India as a cottage industry.

Research on bee-keeping is, however, still in progress in various parts of India.

The work which was previously carried on at the IMPERIAL INSTITUTE OF AGRICULTURAL RESEARCH, PUSA, has been discontinued but a large number of enquiries on methods of bee-keeping were received from various parts of India and indicate that bee-keeping is becoming very popular.

Various items of investigation were carried out by the Government Entomologist, MADRAS, on the technique of hiving, breeding, and swarming seasons, pasturage, granulation of honey, and on the economics of honey production. A bulletin has been prepared and is now in the press. Other investigations are contemplated.

In the PUNJAB several attempts have been made to domesticate migrating plains' bees, but difficulty was experienced in inducing them to enter the hives provided for them.

In ASSAM, the possibilities of developing the indigenous industry of bee-keeping, which is a natural industry in the hills, were under study and observations were made as to the fodders available and as to the factors which influence swarming. It is stated that the public are anxious to take up bee-keeping.

In MYSORE STATE observations on bee-keeping are in progress and considerable numbers of improved hives are maintained. The State Entomologist and a field-man were deputed to Ceylon to study the Queen-bee rearing methods adopted in that country.

Apiculture has been under investigation in TRAVANCORE STATE and is being continued.

CHAPTER IV.

AGRICULTURAL MARKETING.

The reports of the Royal Commission on Agriculture in India and the Central Banking Enquiry Committee drew attention to the loss which occurs through the ineffective marketing of agricultural produce and put forward recommendations for improvement. The Central Banking Enquiry Committee pointed out the need for some central agency to advise and assist in co-ordinating provincial activities, particularly in the case of agricultural produce intended for export and to give assistance to Provincial organisations by way of advice and research. It further recommended that this task should be undertaken by the Imperial Council of Agricultural Research. Although they had accepted in general the recommendations of the Royal Commission on Agriculture regarding market surveys and the appointment of expert marketing officers in the Provincial Agricultural Departments and had in several instances taken such action in that direction as their finances permitted. Local Governments were, in general, deterred by financial stringency from making substantial progress.

The question of agricultural marketing was discussed at the Provincial Economic Conference held in April 1934 and there was general agreement at the Conference that, of all practicable measures for improving economic condition an intensive programme to develop marketing facilities for agricultural products (both crops and livestock products) offers the best immediate prospects of substantial results. The Government decided that the recommendations of the Conference should be given effect to immediately in accordance with a scheme of work prepared by the Marketing Expert Adviser on the staff of the Imperial Council of Agricultural Research.

In view of the urgency of the matter, and in order that the all-India marketing surveys may be as effective as possible, the Government of India agreed to make provision from central funds for a period of five years for expenditure by Local Governments on a nucleus provincial marketing staff consisting of a limited number of marketing officers of a junior grade. The total grant for the provincial staffs was fixed at Rs. two lakhs per annum, which has been placed at the disposal of the Imperial Council of Agricultural Research in the same manner as other grants made by the Government of India to the Council. Subject to a prescribed limit, the necessary allotments to provinces from this grant have been made by the Council in the same manner as grants for agricultural research schemes. The several Provincial Governments promised the Imperial Council of Agricultural Research that they would each appoint their own Senior Marketing Officers who would be in charge of the marketing staff working in the Provinces and co-operate with the Central Marketing Staff.

The work to be undertaken by the Central Staff, in conjunction with Provincial Marketing Staffs, falls into three main divisions, *viz.*,—

(i) Investigation work ;
(ii) Development work ; and
(iii) Work on grade standards.

The programme of work under these various headings may be summarised as follows :—

A. INVESTIGATION WORK.

This includes a series of marketing surveys with immediate reference to the more important commodities grouped as follows :—

I. Crops.

(*a*) Cereals (wheat, barley and rice),
(*b*) Oilseeds (groundnuts, rapeseed and linseed),
(*c*) Plantation and special crops, (tobacco, fibres and fruit).

II. Animal Husbandry Products.

(*a*) Dairy products, etc. (milk and butter, eggs and poultry).
(*b*) Livestock, etc. (hides, skins and wool—Livestock, meat and fish).

Certain general questions are also included within the scope of the surveys, *viz.*, regulated markets, marketing organisation, the problems of transportation, storage and preservation of the commodities dealt with, standardisation of containers, etc.

The marketing surveys, when completed, will set out in detail the present system of marketing of the commodities concerned, not only in each of the provinces separately but in respect of inter-provincial, inter-state and foreign trade so as to provide an all-India picture of existing conditions and a common basis for future progress. The report on each survey will set out, in precise technical detail, definite suggestions for standard grades, containers, handling, methods of packing, contract conditions, etc. Without committing either the Central Government or Provincial Governments, these reports will also formulate proposals regarding any improvements in marketing organisation in the various areas which may appear to be necessary and practicable.

The work connected with the execution of these surveys will be shared between the Central and Provincial Marketing Staffs and the planning of the surveys, compilation of data and preparation of the reports will fall mainly on the Central Staff.

B. DEVELOPMENT WORK.

For each commodity the programme of development work must obviously depend on the results of the marketing surveys but will usually include the demonstration of any recommendations made as a result of the surveys with the object of informing both producers and traders of consumers' requirements and the popularisation of the recommended standard grades, containers, etc. In some instances some small packing stations may be organised (*e.g.*, for eggs and fruits) to demonstrate the practicability of bulk sorting, grading and packing and the commercial advantages of employing the new standards.

More generally, development work will aim at securing the more extensive use of agreed commodity standards, the elimination of waste and the better organisation of producers for marketing purposes. This work will be done in the provinces and will probably fall mainly on the Provincial Marketing Staffs.

C. GRADE STANDARDS.

This is a work of technical character relating to the chemical and physical characteristics of such products as oil-seeds, grains, fruit, etc., and the testing of grading technique and equipment under practical conditions.

The Central Marketing Staff was constituted as an Attached Office of the Imperial Council of Agricultural Research Department with the Marketing Expert Adviser to the Council, Mr. A. McD. Livingstone, as the Head of the Attached Office. This office is called the office of the Agricultural Marketing Adviser to the Government of India and is subject to the same financial and administrative control as other Attached Offices of the Government of India. It was established with effect from the 1st January 1935 and is located permanently at the Old Secretariat, Civil Lines, Delhi.

The Central Marketing Staff consists of the Agricultural Marketing Adviser, six Senior Marketing Officers and Marketing Officers and twelve Assistant Marketing Officers, who have been allotted to commodities and groups of commodities in the manner indicated above. The planning, direction and interpretation of marketing surveys is the responsibility of the Central Marketing Staff, and the work is being carried out in close co-operation with the local Marketing Officers.

Many Indian States, on their own initiative, offered to appoint local officers to co-operate with the Central Marketing Staff. Apart from the Agricultural Marketing Adviser and eighteen Marketing Officers on the Central Staff, forty-seven Marketing Officers have been appointed by the Provinces and Minor Administrations. In Indian States thirty-six Officers are engaged on marketing work and the other Minor Administrations and Indian States have nominated 217 Officials to deal with marketing questions.

A conference between the Central Marketing Staff and the Senior Marketing Officers in the Provinces and States was held at Delhi from 5th to 9th March 1935 in order to arrange a common programme of work. It was decided to complete, in the first year, survey work on wheat, rice, linseed, groundnuts, tobacco, fruits (citrus and deciduous), milk, eggs, livestock and hides and skins, and to deal with other products later. A beginning was thereafter made in all the Provinces and most of the States with marketing survey work on the lines agreed upon at the Conference.

The ready response received from Indian States and Provincial Governments to their invitation to examine the all-India aspects of agricultural marketing justifies the hope that, by a great combined effort, results of substantial benefit to Indian agriculturists will be achieved.

CHAPTER V.

AGRICULTURAL ENGINEERING.*

1. Hydraulics.

During the period 1933-34 and 1934-35 under review, the installation of tube-wells, borings, lift-irrigation and the construction of embankments and channels have received considerable attention in most of the Provinces as well as some of the States.

The installation of large tube-wells of 9″ to 12″ diameter is chiefly confined to the United Provinces, Bihar and Orissa and the Punjab, where considerable progress has been made in such irrigation installations.

In the UNITED PROVINCES, the number of tube-wells installed in 1933-34 was 330, consisting of 83 tubes of 5″ and over in diameter and 247 of $3\frac{3}{8}$″ diameter. In the following year the number of projects completed was 458 consisting of 204 tube-wells of 5″ and over in diameter and 254 of $3\frac{3}{8}$″ diameter.

The preponderance of 5″ and 6″ tube-wells was particularly noted, and appears to be due to the fact that such sizes are being commonly adopted in the hydro-electric grid area. In 1934, there was further development of tube-wells in the electric grid system where the Irrigation Department, in close co-operation with the Agricultural Department, have started a five-year scheme of tube-well construction.

In the PUNJAB 118 tube-wells of 5″ and under in diameter were installed during 1933-34. In the following year, the number rose to 169. The composite type of strainer was generally used, though in some installations the stone-ware or cadmium plated Phoenix strainers were used. A new type of slotted pottery strainer is being tested. Three tubes fitted with eight feet lengths of 6″ coir strainers which were installed in February 1934 for trial purposes are under observation.

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There has been a marked improvement in the demand for tube-well installations in BIHAR, where 119 small tube-wells (5″ and under in diameter) and four tubes of 12″ diameter were installed in the year 1933-34. In the following year, 118 tube-wells of 5″ and under in diameter as well as nine tube-wells of 6″ to 12″ diameter were installed. In most of the tube-wells the Sabour type of strainer, designed and manufactured by the department to suit local conditions, was used.

An interesting experiment was carried out at the Agricultural Farm, Kanke, where the shortage of water for the irrigation of fodder crops was acute. A length of 9″ strainer was laid horizontally across the dry bed of the Jamuar river at a depth of about five feet below the surface. An adequate supply of water was obtained. The experiment has proved successful so far and probably many other hill streams could be similarly tapped.

2. Well-boring.

In most provinces the Agricultural Department maintains staff for the improvement of village wells by boring. In the UNITED PROVINCES, the number of borings made in 1934 was 1,806 and in the following year 1,824, the percentage of success being 73·2 and 71 respectively.

In the PUNJAB the total number of wells bored was 263 in 1933-34 and 270 in 1934-35.

In BIHAR AND ORISSA 216 borings were sunk in 1934, of which 177 were successful. In 1935, 296 borings were made, of which 227 were successful.

In MADRAS the number of borings put down and the depth bored in 1934 were 1,047 and 62,309 feet respectively of which 629 were successful. Of these, eleven were artesian bore-holes; seven in the Bezwada Division were discharging water from 4 to 300 gallons per minute from 2½ feet to thirteen feet above ground-level and four in the Tanjore Division were giving from 300 to 22,250 gallons per minute. The height of discharge ranged from 4′—10″ to 14′—2″ above ground level. An artesian spring, tapped by a hand-drill at Neivety village six miles from Ultangamangalam station, Vriddachalam Taluk, South Arcot district, yielded a supply of 2,250 gallons of water per minute at 14′—8″ above ground level. As a result of tapping of these springs, the value of the lands benefited thereby has considerably increased.

In 1935, 1,175 borings were sunk out of which 269 were successful. During the year twelve artesian springs were tapped—nine in the Bezwada Division discharging 9 to 275 gallons of water per minute and three in Tanjore Division of which two are brackish springs and the third discharges fresh water at the rate of two gallons per minute at 2½″ above ground level.

3. Water-lifts and Lift Irrigation.

The installation of large tube-wells, already referred to, involved the provision of suitable power-pumping plants, and in the Punjab and the United Provinces advantage is being taken in the districts served by the hydro-electric grid system of electrified installations.

In BIHAR AND ORISSA various types of water-lifts were demonstrated at the Agricultural Exhibitions. The success of the demonstrations attracted the attention of a large number of interested agriculturists. During the period under review, two turbine pumps capable of delivering 60,000 gallons per hour were installed, one at Chakia and the other at Purtabpore, both in Saran district. An electric pump, capable of delivering 3,000 gallons per hour with necessary distribution pipes, was also installed on a 5″ tube-well at Patna. The demonstration of the simple and efficient Archemedian Screw Pump has produced a large number of enquiries and a demand for a cheap type of low water-lifts. Several purchasers were supplied with drawings and detailed instructions for the manufacture of the lift by the village carpenter and blacksmith.

In MADRAS the Industrial Engineer erected thirty-seven and forty-six pumping plants in 1934 and 1935 respectively, on payment of a nominal fee on the capital cost of machinery installed, thereby bringing under irrigation fifty-six and 516 acres respectively. Thirty-three pumping plants were maintained by the department during years under review for hire to cultivators to pump water to their crops during the period of droughts or for well sinking purposes. In the Central Provinces two pumping plants were erected in 1933-34.

4. Improved Water-lifts for Bullock-Power.

The all-metal Persian wheel, which has now attained a high standard of efficiency, is gaining considerable popularity in the Punjab, Bihar and Orissa and the Central Provinces.

In BIHAR AND ORISSA the demand for *rahat* bullock-power lifts continues to be satisfactory and several pumps were sold by the Department direct. A number of Indian foundries and *mistries,* who also manufacture these lifts, report satisfactory sales. Due to keen competition the market prices of *rahats* have dropped to Rs. 225 and Rs. 150 for the large and small sizes respectively as against Rs. 250 and Rs. 175 charged by the Department.

In the PUNJAB in 1933-34 the improved Persian wheel bullock-drive, as well as an electric-drive, were demonstrated at the All-India Industrial Exhibition held in Lahore and both were much appreciated by the farming community. In 1934-35, three improved Persian wheels, for which Government awarded a special prize, were manufactured for various Government institutions. Well owners, desirous of purchasing these improved wheels, experience great difficulty in having them made by private agency. Until some arrangement is made with some firm or firms to manufacture them on a mass scale, they cannot be produced at a reasonable cost.

The Research Engineer, Coimbatore has conducted a series of experiments during the past years with various makes and types of water-lifts which have now resulted in the development of an improved type of Persian wheel for South India. These particular lifts have been installed for demonstration purposes on several Agricultural Research Stations.

In BURMA the Persian wheel was also given much attention and the design finally produced was an improved all-metal type suitable for lifts up to fifty feet and driven by locally made bullock gear.

5. Embankments and Channels.

Embankments and channels are the two chief factors of irrigation and land improvement in India. These are essential in a country where a large percentage of the annual rainfall runs off the fields into *nallas* carrying with it much fertile soil. But in order to check such flow or wastage of water and erosion and also in the economical distribution of water where surveying and levelling is necessary, material help can be offered to cultivators by technical staffs who can take levels. Most provinces maintain such staff for the surveying, levelling and designing of minor projects, which are not ordinarily undertaken by the Irrigation Department. In BIHAR AND ORISSA, one Inspector with one surveyor, is employed to assist agriculturists, in this respect. In 1933-34 nine irrigation schemes were surveyed and plans and estimates were furnished, while in 1934-35 thirteen such schemes were surveyed and plans and estimates prepared. In addition, four and six minor works were carried out by the Department in 1933-34 and 1934-35 respectively.

In BENGAL, several surveys were undertaken for irrigation and other purposes and plans were supplied.

In 1933-34 a small sum was allotted to the Professor of Agricultural Engineering, Poona, for research on the details of the soil erosion problem including the process of erosion on cultivated and non-cultivated lands under different conditions and the designing of suitable means of soil preservation. Observation plots were selected and very carefully surveyed and levels recorded.

6. Agricultural Machinery.

The sugar power-crushers designed by the agricultural departments in the United Provinces, Bengal and Bihar and Orissa are giving satisfactory results. In the PUNJAB the sugarcane crusher, designed by Mr. Brownlie, was fitted at Lyallpur and preliminary tests were carried out; certain recommendations for alteration have been forwarded to the designer.

An efficient power crusher of the pattern crusher is now manufactured by Dr. N. Singh of Phillaur and tests carried out so far go to show that it will suit Punjab conditions.

In BENGAL improvements have been made in the cane-crushing mills and several sugar factories on the open pan system have installed mills that have given satisfaction.

Two improved power-crushers of 1½ ton and two tons capacity have been designed and are now under test.

The "Phonex" cane-crusher was designed and manufactured by Messrs. Jessop & Co., Calcutta, in collaboration with the Sugar Technologist to the Imperial Council of Agricultural Research. The test figures were remarkably satisfactory. The final suggestions for improvement have been forwarded to the manufacturers for incorporation in the commercial model.

In BIHAR AND ORISSA further improvements in the bearings, lubrication and grooving of the rollers of the Bihar 'Senior' and 'Junior' three rollers power cane mills, designed by the Agricultural Engineer were carried out. Under test it was found that the Bihar 'Senior' mill did not require more than twelve B. H. P. when working on a full load of thirty maunds cane per hour. For the 'Junior', crusher an engine of eight B. H. P. was found to be sufficient to work the mill when crushing twenty maunds of cane per hour. During 1933-34, five Junior crushers were purchased by the Department for Central Farms and demonstration purposes. In addition, two Bihar Senior crushers were purchased by the Dhuli and Barauli concerns.

The "Sukhada" implements consisting of a three-five tined cultivator, furrow and broad share are gaining in popularity, as stated last year. There has been also a good demand for the modified Egyptian Noorag Thresher manufactured by the Department.

The Bihar and Orissa Department has also designed and improved instrument for testing rind hardness in sugarcane. It is constructed on the principle of the presometer and consists of a measured capacity spring encased in a cylindrical barrel. The spring rests on a piston which has an extended rod with a hole at its free end to hold the needle. A groove has been cut in the barrel to permit of movement of a pointer which has been fixed with piston and indicates the pressure exerted. This instrument has also proved useful in studies on the cohesion and penetrability of soils.

In the Punjab the designing of a suitable winnower without conveyor has been taken in hand. The impeller pump designed by Mr. Brownlie was tested in the workshop. A lift and force pump was designed and manufactured in the shops at a cost of Rs. 250 as no suitable pumps were available in the market for lifting water from a depth of eighty feet or over at a reasonable cost. A bone crusher designed for the prize offered by the Imperial Council of Agricultural Research by Mr. Guiness, Chief Draftsman to the College Workshop, has been manufactured at the College. It has not yet been completely tested. In the Central Provinces a new combined groundnut lifter and plough was made for the Economic Botanist for cotton.

In MADRAS the mechanical seed-drill, which has been under development for several years, has been further improved by the provision in the seed distributor of a cast iron base for the rotating seed plate and the elimination of several adjustments.

A small precision cotton seed-drill has also been designed for the Cotton Specialist. The bund-forming implement, as reported in the previous report, was demonstrated during the period under review and a satisfactory sale is reported by the manufacturers. In Bombay, the new seed-drill was given exhaustive trials and it was found that it could work even in wet soil. The rotary groundnut-digger built at the workshop gave satisfactory result. A lemon juice extractor and a soil scooper were also manufactured in the workshop and tests are being carried out.

In BENGAL, 'Chasa' and 'Deshbandu' ploughs have been redesigned. 'Sobkans', 'Amirs' and 'Bunglas' ploughs have been selling well. In Mysore the improved seed-drills, designed by the Department was further improved to suit the sowing of *jola* also and demonstrated at the Dasara Exhibition.

7. Mechanical Cultivation.

A fairly detailed account of the progress of mechanical cultivation in India was given in the last review and reference was made also to the Scientific Monograph No. 9 published by the Imperial Council of Agricultural Research on the subject. The results of the experimental work carried out from 1930 to 1934 are contained in this Monograph. In 1934-35, the Imperial Council of Agricultural Research made a grant to the Burmah Shell Company for continuing the experimental work for one more season. Special importance was attached to investigations on the best plough-share for weed eradication in black soil areas and on the working life of tractors. As a result of the experiments, it has been claimed that a minimum economic working life of 8,000 hours could be safely assumed and that with the constantly improving design of tractors and consequent strengthening of parts, the life of a tractor would become longer and longer. The experiments also indicate that the Mouldboard plough is the most suitable for grass eradication, since the soil is inverted and the grass is left on the surface so that it cannot take root again, being killed by the sun. It has also been found that the Rotary Tiller and the Mouldboard plough both brought up a great deal of sub-soil and the latter has been improved with cut away sections which will enable the top six inches to be inverted and the lower soils only to be broken up. Mention may be made of the practical work carried out by Messrs. Karnatak Agricultural and Transport Company in mechanical cultivation, on the land owned by the Phaltan Sugar Company in the Phaltan State. It has been found that the use of Mouldboard ploughs leaves the ground more open than the use of the Rotary Tiller and that better results can be obtained with the Rotary Tiller in lands infested with *hariali* if ridging is not carried out at the time of ploughing. Emphasis has also been laid on the desirability of fitting up time recorders to all tractors as this will enable owners and managers to see at a glance for what periods the tractor was working and will bring to light any slackness or negligence on the part of the tractor drivers. The same company carried out a considerable amount of contract tractor-ploughing in Dharwar District, Savanur State and Bellary District. With McCormic Deering Tractors the cost per acre was found to be about Rs. 8-13 which compares very favourably with the results obtained during the 1934 experimental work with kerosine and diesel tractors. Progress has also been made with work on the designing of the most suitable ploughs for use in

PLATE II

MECHANICAL INTERCULTURE OF TEA.

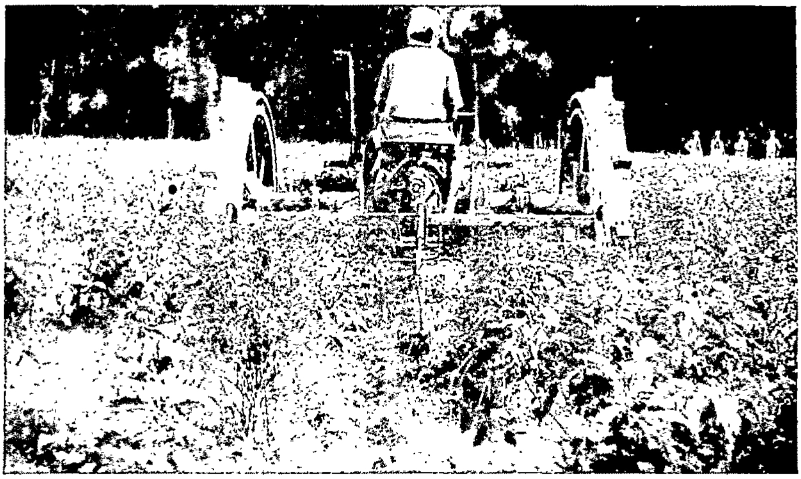

Fig. 1.

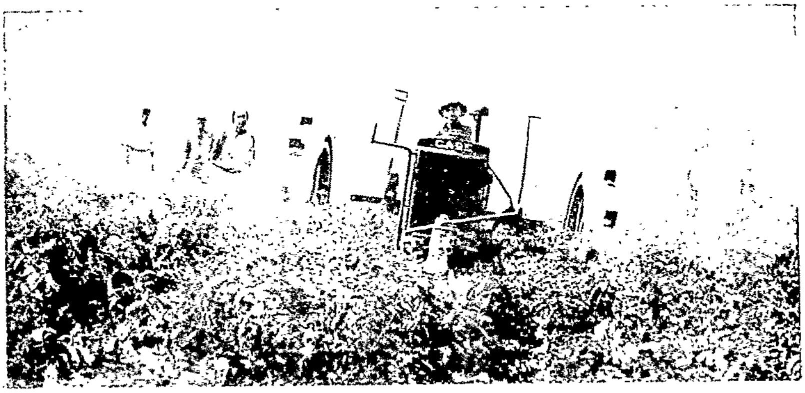

Fig. 2.

the conditions prevailing in India, especially to deal effectively with weed eradication.

Generally speaking, much interest has been shown by trade organisations, commercial firms and large land owners, in the possibilities of mechanical cultivation with tractors. It is proposed under the schemes of agricultural engineering development in many provinces to institute a series of tractor trials upon the results of which may be decided the most suitable types of tractors to suit local conditions. An exhaustive test of tractors has been carried out at Pusa and valuable working data for the past years on various types of tractors are incorporated in special literature maintained for general information. Experiments with tractors are being carried out in the Punjab, Central Provinces, Bombay, the United Provinces and the Indian States.

A recent development of mechanical cultivation in India has been the use of tractors in the inter-cultivation of tea. The J. I. Case Company have made an alteration in their C. C. Model (17-27 H. P. three-wheeled) by which the back axle is of sufficient width to allow of the axle straddling two lines of bushes, the wheels travelling in the outer furrows and the single front wheel running in the furrow between the lines. The wheels are of sufficient size to enable the tractor chassis to clear the bushes and the centre furrow and the two outer furrows are cultivated by a three-shovel cultivator. This outfit was tried in Assam near Jorhat in December 1935 and did useful work. There are possibilities of the extension of this type of inter-cultivation if gardens are planted in a manner suitable for mechanical cultivation.

8. Electricity in Farming Operations.

This note briefly outlines the extent to which electricity has been brought to the aid of agriculture in the western districts of the UNITED PROVINCES during the period 1933-35.

The source of power is the Ganges Hydro-electric grid scheme which, by harnessing successively five of the eight larger falls on the

Upper Ganges Canal as load developed, has enabled power to the extent of 12,000 K. Ws. to be transmitted over eight districts comprising a total area of some 12,000 square miles. Two further canal power stations and a steam-driven plant in the east of the tract are now under construction. A total output of about 29,000 K. Ws. will be available by 1937. Of this, 16,000 K. W. is being allocated to irrigation and agricultural purposes.

Power is transmitted by means of the main net-work at voltages of 66,000 and 37,000 to distribution stations located over the area from which a secondary series of branch lines at 11,000 volts serve individual towns and groups of towns. There is also an expanding tertiary or rural net-work, at 11,000 volts, to energise the intervening tracts including the State tube-well systems and many isolated agricultural farms.

The initial objectives of the grid scheme were to supply power to irrigation pumping stations for lifting water from rivers, flowing at low levels, for irrigating tracts hitherto uncommanded by the existing canal systems. At the same time, power was to be supplied to all towns and urban areas having each a population of 5,000 or over in the districts affected. Under this aspect of the scheme, power has already been supplied to eighty-eight towns for domestic and minor industrial purposes. Demand for electricity having been established in the area, arrangements have been made for expanding the supply of power by means of the tertiary net-work both to the State tube-well system and to farm installations under the conditions described below.

In tracts having an uncertain rainfall and uncommanded, or only partially protected by canals, the provision of extended irrigation facilities was the first requirement and the development of the project has been directed with that end in view.

Two-hundred cusecs are being lifted from the Ramganga river to a height of 36 ft. for the protection of 100,000 acres in Bijnor and Moradabad districts by means of two electrically driven pumping stations. 190 cusecs are also being pumped from stations on the Kali Nadi in Aligarh and Etah districts for supplementing the supplies in the lower reaches of the Ganges Canal. Irrigation has been considerably expanded as a result of this system.

In the dry tracts uncommanded by river-fed canals, extensive experiments were made during the years under review, in pumping water from the sub-soil by means of a system of State-owned tube-wells. Up to the end of 1935, some 750 State wells were installed and an equal number are now under construction. The standard type of State-owned well is designed to deliver 33,000 gallons per hour from the underground reservoir at an average depth of 20 ft. below ground. The vast majority of the wells are equipped with a 12·5 H. P. motor pump energised by a local transformer stepping down the line pressure from 11,000 to 400 volts. Each State well commands on the average about 1,000 acres of culturable land with a spacing of roughly 1½ miles between the wells of the various groups. 125 acres of sugarcane, 60 acres of cotton or maize and 240 acres of wheat can be irrigated yearly by each well during the 3,000 hours for which demand for irrigation is estimated to prevail. A total area of some 750,000 acres of irrigation will shortly be irrigated by the scheme.

The system of sale of water on the State tube-wells is novel. The quantitative or volumetric method has been adopted in order to discourage waste by the cultivator. There is the additional advantage that, should rainfall occur during the period of the crop, the cultivator is commercially benefited to the extent of the saving he can effect on the purchase of water. It will be recalled that the Royal Commission on Agriculture (1927-28) in their report strongly advocated the adoption of volumetric method of sale.

Water is sold in terms of the energy required to pump it as measured on the electric meter. Approximately 4,000 gallons are delivered per unit of electricity consumed.

In the case of sugarcane, allowing 110,000 gallons per acre, each watering requires 27½ units. In the case of wheat, requiring 88,000 gallons per acre, twenty-two units are needed. The rates for current vary slightly throughout the area according to the yield in gallons per unit at the different wells with spring levels at various depths.

The average rates in force are As. 2-3 per unit during the sugarcane season, *i.e.*, from April to September inclusive, and Anna 1-6 during the *rabi* season. With the normal number of waterings, the equivalent crop rates are about Rs. 16 per acre for sugarcane and Rs. 4-4 for wheat against Rs. 10 and Rs. 5 respectively obtaining on the Ganges Canal.

In addition to the State tube-well scheme, considerable progress was made on the electrification of privately owned tube-wells and farms during the period under review. Some 180 private tube-wells have been electrified by means of a system of local branch lines radiating from the 11,000 volt rural net-work. Low tension current is supplied at the tube-well at a rate of 1 anna per unit for the first 1,200 units consumed in the year per H. P. connected. All subsequent units are charged at half an anna, in order to encourage the development of such irrigation. Assuming 3,000 hours operation of a well during the year, the average rate for energy sold is 9 pies per unit which is equal to the rate for current in force on the State scheme. In spite of the rapid expansion of the State wells in the grid area during the years under review, there has been a steady increase of private tube-well irrigation which continues to develop.

Including State and private irrigation more than 1,750 cusecs were being pumped electrically from tube-wells and rivers in 1935, a discharge which will shortly reach 3,200 cusecs.

Apart from irrigation, current is sold at the zamindars' substations throughout the area at 1 anna per unit for motors used for processing their own agricultural products. For industries other than agricultural, a retail rate of Anna 1-6 per unit is charged with an alternative tariff for seasonal loads. A two-part tariff based on the consumer's load factor is also quoted.

The following particulars in regard to the development of electrified agricultural industries will be of interest.

Flour milling comprised by far the greater proportion of the minor industrial loads. During the period under review there were some 465 flour-motors in operation in the electrified area, both urban and rural, with a total H. P. of 4,162. The average rate charged by flour-millers for grinding flour has been reduced to half that prevailing before the introduction of electricity.

About a dozen cotton ginning plants were in operation during the period with a total installed load of 280 H. P. Some eighteen oil mills were electrified with a total installed load of 400 H. P. Many of these mills by working long hours have taken advantage of the low rates prevailing on the sliding scale.

In regard to sugar processing, hydro-electric power has been confined to driving small cane crushing plants and centrifugals on farms and in urban areas, the juice being treated in open boiling pans. There are some 163 such plants connected to the grid with a total installed motor capacity of 1,113 H. P. In the case of the larger sugar factories, where steam is required for the vacuum pans and other processes, hydro-electric current is used in certain cases for lighting, pumping and workshop purposes during the off-season. The main machinery of such factories is driven by steam power.

An experiment was recently conducted by the Irrigation Department with the object of exploring the difficulties inherent in the operation of small vacuum pan factories in outlying areas by electric motors worked in combination with steam plants. The results obtained are being analysed but it seems unlikely that any material demand will develop for hydro-electric power in the case of large or medium size white sugar factories.

In addition to the direct relief afforded by means of power irrigation within the electrified districts, indirect aid is also being given to the southern districts outside the grid area in various ways.

The sinking of tube-wells in Muttra and Agra is not possible on account of geological reasons. These districts are, however, partially irrigated by branches of the main Ganges Canal. In order to supplement the sparse canal supplies already available for these systems, tube-wells, energised by grid power, were sunk in the Meerut district and water was pumped therefrom into certain local channels hitherto fed from the main canal. The river water thus released is being passed down to Muttra for extending irrigation.

Another system under trial is direct pumping from large tube-wells into the Main Canal in the Meerut district. The results of these experiments are being observed and should they prove successful, they will be extended.

The resources of electric engineering are thus gradually being brought to the relief of the countryside and it is hoped that a period of enhanced prosperity will result.

CHAPTER VI.

DISTRICT WORK.

Mention was made in the previous review of the reduction in the district staffs of provincial agricultural departments consequent on a period of financial stringency and retrenchment operations. During the period under review, there has been a perceptible improvement in the position and modest increases in the district staffs of some of the provinces are in sight. The total number of officers in the Superior, Provincial and Subordinate Grades of the Agricultural Departments in British India, engaged on district work, during 1934-35 was 46, 99 and 1,517 respectively, the corresponding numbers during 1932-33 being 49, 99, and 1,369.

An important development during the period was the grant of a crore of rupees by the Government of India for distribution to the various provinces for the economic development and the improvement of the rural areas.

1. Demonstrations.

The demonstration of agricultural improvements under cultivators' conditions is still an essential portion of the work of the Indian Agricultural Departments, and, as in previous years, the village demonstration plot on the cultivator's own land is the most effective form of propaganda. During the period under review, considerable attention has been given to the possibility of setting up an organization which will enable the greater part of a province to be covered by such demonstrations in a reasonable time and without incurring prohibitive expenditure. Such organization is the more urgent in that, in most provinces, the Agricultural Departments have for many areas at least a whole body of improved practice ready for demonstration and not merely individual improvements.

MADRAS. The system of concentrating demonstrations on cultivators' lands at a few selected centres, which was started in

1930-31, was continued and modified during the period. In order to increase the number of demonstration plots and at the same time to concentrate the work in a definite number of villages, each demonstrator was allowed to extend his activities over eight to ten demonstration centres. The total number of demonstration plots increased from 1,746 in 1933-34 to 3,170 in 1934-35, as against 2,733 during 1932-33. The principal demonstrations were improved varieties and better cultural and manurial methods for paddy, sugarcane, *ragi* (*Eleusine coracana*) and groundnut and the manufacture of jaggery using improved cane-crushers, furnace and other appliances. Demonstrations were also conducted with improved iron ploughs.

BOMBAY. Demonstrations on cultivators' lands numbered 1,560 and 1,754 respectively in the two years under review, as against 1,637 in 1932-33. The district staff and the *Taluka* Development Associations devoted special attention to the Government scheme of village improvement launched during 1933-34.

In the North Central Division the plan of intensive propaganda consisted of dividing a *taluka* into five suitable groups, each in charge of a *kamgar* (farm-trained labourer for propaganda), who would do house-to-house propaganda in five villages in the first year and extend the same to an additional five villages every year, and thus complete his group within a period of five to six years. The improvements included in the propaganda work were the introduction of iron ploughs, Banilla cotton, Akola *bajri* (*Pennisetum typhoideum*), improved strains of wheat, pure Spanish peanut and sulphur dusting against *jowar* smut.

SIND. The district staff was considerably strengthened as the scheme for the development of agricultural propaganda was sanctioned by Government. The Indian Central Cotton Committee made a munificent grant of Rs. 2,96,540 for demonstration and propaganda directed to the more extended cultivation of improved cottons in the Lloyd Barrage areas. The Sind cotton extension scheme was organised in two sections, one on the left and the other on the right bank of the Indus. The growing popularity of cotton with the Right Bank cultivators can be gauged from the fact that during the *kharif* 1932 the area under cotton was 385 acres only, while in the *kharif* 1935 there were 17,455 acres under cotton. Six auxiliary demonstration farms have been started in the Barrage areas, their main function being to carry out demonstration and propaganda amongst cultivators towards the introduction of improved methods of cultivation and improved varieties of crops. The introduction of regular "Farmers' weeks" at various research stations and auxiliary farms helped to popularize improved methods of cultivation.

BENGAL. The practical demonstrations of tested improvements carried out by the Department numbered 2,256 in 1933-34 and 3,510 in 1934-35, as against 2,709 in 1932-33. Propaganda for jute restriction was carried on intensively by the department during the year.

UNITED PROVINCES. Practical demonstrations of improved crops, implements and green manuring totalled 8,203 in 1933-34 and 10,376 in 1934-35, as against 23,966 in 1932-33. The area affected by the demonstrations was 38,686 acres in 1933-34 and 85,890 acres in 1934-35. The number of private farms which are worked under departmental supervision increased from 1,332 in 1932-33 to 1,347 in 1933-34 and 1,367 in 1934-35. A special better-farming campaign was conducted in the Sarda canal area (now a separate agricultural circle). Demonstration carts, equipped with exhibits of improved seeds, implements and trained ploughmen, carried out demonstrations in a number of villages. These demonstration carts were found useful in other circles also. Better-farming societies increased in number and efficiency.

PUNJAB. The total number of demonstration plots on cultivators' lands increased from 2,199 in 1932-33 to 2,420 in 1933-34 and 2,900 in 1934-35. An intensive campaign was carried out in the South-east Punjab to control the insect pests of sugarcane: and also to control the gram-blight disease in Attock District. The campaign against *pohli* was continued and intensified. Farmers' weeks were organised at the experimental farms at Jullundur, Gurdaspur, Lyallpur and Rawalpindi, in which attendance totalled 18,000.

BURMA. The number of demonstrations on cultivators' fields totalled 2,470 in 1933-34 and 2,182 in 1934-35, as compared with 1,590 in 1932-33. Demonstrations of the treatment of *pyaung* (*Sorghum vulgare*) seed against grain smut were given in twenty-three villages. With the help of a grant from the Indian Central Cotton Committee, the department increased the number of demonstrations in Meiktila and Myingyan Districts from six to twenty-five and conducted demonstrations of improved methods of cultivation of cotton at eighty-five centres in the two districts. The use of improved cotton seed, growing the crop in rows, preparing the land in autumn for the following year's crop, using inter-cultivation methods and the conservation of manure were the important improvements demonstrated. In Lower Burma demonstrations consisted mainly of improved paddy varieties and trials with fertilizers, while in Upper Burma they were designed mainly for the introduction not merely of new crops but of new methods of cultivation.

BIHAR AND ORISSA. The number of *kamdars* (farm-trained labourer for propaganda) employed by the department for demonstration work during 1933-34 was eighty. Thirty more *kamdars* were sanctioned by the Government during 1934-35. The total number of field demonstrations carried out was 9,734 in 1933-34 and 14,580 in 1934-35, as against 9,358 in 1932-33. During the last six years there has been a 400 per cent. increase in the work done in this respect. That the demonstration achieved useful results can be judged from the fact that 10,700 mds. of cane seed, 4,105 mds. of seeds of other crops were distributed during 1934-35. The flood relief operations in Orissa and the earthquake relief work in North Bihar curtailed the normal activities of the Department, as agricultural overseers and *kamdars* had to be temporarily diverted to duties of an urgent nature in connection with the earthquake. The first problem to confront the Department was the disposal of the large sugarcane crop which was left standing in the fields owing to the damage from earthquake sustained by eight large sugar factories. Rapid arrangements were made for instructing ryots in the proper method and technique of producing good quality *gur* and for giving assistance in the purchase of crushers and *gur*-making pans. It is gratifying to note that the cultivators concerned were able to make good quality *gur* acceptable to refineries and made good profit also, as a result of the rise in price of *gur*. A considerable quantity of surplus sugarcane was also disposed of to factories outside the area affected by the earthquake.

The second problem was the regeneration of cultivated lands affected by sand deposits. Twenty peripatetic demonstration parties, equipped with bullocks and suitable implements for carrying out sand clearances, were got together. The parties moved from village to village, giving demonstrations of the use of implements and actually reclaiming at least one plot in each village visited. Simultaneously demonstrations and propaganda were carried out for the regeneration of sand-affected land by the incorporation of organic matter with a view to improve the soil texture. Large quantities of sunn (*Crotalaria juncea*) and *dhaincha* (*Sesbania aculeata*) were distributed to cultivators.

CENTRAL PROVINCES. The number of practical demonstrations carried out was 5,572 in 1933-34 and 6,234 in 1934-35, as against 4,709 in 1932-33. In addition, a number of demonstration plots was worked, some by the Department on rented land and others by the cultivators themselves on their own land under the direct supervision of the Department. The latter are naturally more effective as demonstration centres, because the owners bear all the expenses and retain the produce and thus have practical experience of the monetary effect of the improved methods. Such plots showed substantial profit, in the Eastern Circle ranging from Rs. 5 per acre to nearly Rs. 20. In this Circle thirty irrigation plots, twenty under Kharung and ten under Maniari Reservoirs, demonstrated the advantages of irrigation to the rice crop.

ASSAM. The number of practical demonstrations carried out was 4,054 in 1933-34, 3,258 in 1934-35, as against 3,169 in 1932-33. The main items were demonstrations of superior varieties of rice, potato and sugarcane, the use of cowdung and bone-meal as manures, introduction of new crops and improved implements and spraying demonstrations to check potato blight.

NORTH-WEST FRONTIER PROVINCE. Village tours, surveys of agricultural conditions, demonstrations of improved implements and lectures and shows at organised meetings of agricultural associations were arranged in the Districts of Bannu, Dera Ismail Khan and Kohat to bring home to zemindars the tested improvements advocated by the Department.

HYDERABAD. The number of demonstrations on cultivators' holdings carried out by the Department was 1,288 in 1933-34 and 1,911 in 1934-35, as against 924 in 1932-33.

MYSORE. The number of demonstrations carried out by the Department was 1,418 in 1933-34 and 1,648 in 1934-35, as against 1,123 in 1932-33. A successful campaign was undertaken to avert a wide-spread scarcity of fodder that appeared imminent, consequent on the failure of the South-west Monsoon. As a result of demonstrations in spraying conducted on the Coffee Experimental Station at Balehonnur, an area of 20,000 acres of coffee is reported to have been sprayed by the planters during 1933-34.

BARODA. The number of practical demonstrations on cultivators' holdings carried out by the Department was twelve during 1933-34 and nine in 1934-35. The work of the District Staff in Navsari District consisted in the extension of 1,027 A. L. F. cotton and eradication of inferior type of cotton like Goghhari.

TRAVANCORE. The number of practical demonstrations carried out by the Department on cultivators' fields was 154 in 1933-34 and 201 in 1934-35, as against 140 in 1932-33. The principal items of demonstrations were improved methods of paddy and coconut cultivation.

COCHIN. During 1933-34, sixty-two demonstrations on paddy, sugarcane and coconuts were given by the department. The expenditure on account of demonstration amounted to Rs. 1,182 against Rs. 828 in 1932-33.

BHOPAL. The number of practical demonstrations carried out by the Department was twenty-six in 1933-34 and forty-four in 1934-35, as against fifteen in 1932-33. The agricultural staff visited every *tahsil* at least once and the nine co-operative demonstration plots scattered over the State at least four times in 1933-34 to demonstrate better methods of cultivation, improved seed, etc.

2. Other Forms of Propaganda.

MADRAS. All the districts except the Guntur circle and the Nilgiris were toured by the three motor exhibition units, and officers of the Industries, Fisheries, Veterinary and Public Health Departments toured with the exhibition vans and participated in demonstrations and exhibitions. A large number of castrations by the Burdizzo method was done in South Canara District by the Veterinary Assistant Surgeon who accompanied the exhibition van.

SIND. A touring propaganda party, equipped with portable magic lanterns sets of slides illustrating the work of the department, held lectures and exhibitions and brought to the notice of the cultivators the efforts of the Department towards agricultural improvement. Posters illustrating the advantages of adopting cotton cultivation in the right bank of the Indus was displayed at railway stations and in important thoroughfares and public offices. As a result of the work of the cotton extension scheme in the Right Bank areas, about 4,000 acres were under cotton in *kharif* 1934 and there was every indication that a large increase in cotton cultivation would take place within a few years' time.

BENGAL. The Publicity Department introduced a publicity van with a loud speaker for tour in the districts. Nine talks on different agricultural subjects were given by the expert officers of the Department through the Calcutta Broadcasting Station. The training of *bhadralok* youths in practical agriculture at the Faridpur farm with the object of settling them on *char* land was continued.

UNITED PROVINCES. Kiosks were erected in seven important railway stations and certain collectorates, equipped with exhibits and charts illustrating the various activities of the Department. Agricultural signboards, giving information where data on important crops, implements and fruit culture of the locality can be had, were fitted up at twelve stations of the East Indian Railway.

PUNJAB. In the Nili Bar Colony, Government introduced in 1930 a scheme to encourage competition in the adoption of improved methods of cultivation by which one rectangle of land was reserved in each of twenty villages in the Colony and grants of half a rectangle each were made to the two best farmers in each village who cultivated their own land in the best methods during the previous year. The successful candidate holds the grant for three years and it is then re-awarded in fresh competition. These prizes have helped the propagation of improved agricultural methods in the Colony.

BIHAR AND ORISSA. Demonstrations and lantern lectures formed regular features of the extension work of the department. During 1933-34 twenty peripatetic demonstration parties, under the charge of an Assistant Director of Agriculture, were equipped with suitable implements and bullocks for carrying out demonstrations on sand-clearance in the earthquake affected areas. Better-farming campaign was carried out in 105 villages.

CENTRAL PROVINCES. "Farmers' Day" celebrations were arranged on each of the farms and on some of the private and Government plots as well. This, it is reported, would be a regular feature in future, and will help to bring the growers in closer touch with the work of the Department. The cinema van demonstrated at forty-five centres and the provision of two more cinema outfits for demonstration work in the ensuing year would considerably increase the activities of the Department in this direction.

3. Agricultural Exhibitions.

MADRAS. One hundred and ninty-seven Agricultural exhibitions and shows with lectures were arranged during 1933-34 and 178 during 1934-35 on occasions like cattle fairs, *jamabandi* camps, health week celebrations and district co-operative conferences, as against 168 in 1932-33.

BOMBAY. The Department organised twenty-two agricultural shows in 1933-34 and forty-four shows, including three cattle rallies and hundreds of demonstrations for special items of improvements, during 1934-35. Considerable propaganda was carried on by the *taluka* development associations and co-operative societies.

BENGAL. During 1933-34 the Department of Agriculture participated in thirty-nine exhibitions and fairs. During 1934-35 the Department contributed grants to twenty-three exhibitions.

BIHAR AND ORISSA. The Department held agricultural shows in the *melas* (exhibition) at Sonepur, Hijla, Bihta, at the Bihar and Orissa Provincial Exhibition at Patna, at the Animal Welfare Exhibition in Ranchi and at the All-Orissa Agricultural and Industrial Exhibition held in Cuttack. At all these meetings bulletins were distributed, improved seeds, implements and fertilizers were displayed and demonstrations in *gur* and sugar-making were also given.

CENTRAL PROVINCES. The number of agricultural shows and fairs held was forty-nine and sixty-four respectively during the two years under review, as compared with twenty-eight in 1932-33.

MYSORE. As in the previous year, the Department organised at the Dasara Exhibition a strikingly good show demonstrating the activities of the Department and its various recommendations.

4. Agricultural Associations.

MADRAS. A number of District Agricultural Associations interested themselves in agricultural improvements. The Trichinopoly District Agricultural Association distributed 10,000 lbs. of paddy seed. The Tanjore Delta Mirasdars' Association at Mayavaram conducted an agricultural show at Aduturai. The District Advancement Association, South Canara, organised a flower and vegetable show at Mangalore. The Agricultural Association at Palghat maintained a breeding bull and lent a few iron ploughs to the cultivators.

BOMBAY. The number of *Taluka* Agricultural Development Associations, which helped to popularise the agricultural departments' demonstration work, was sixty-nine during 1933-34 and seventy-four during 1934-35. Subsidies amounting to Rs. 37,600 were granted during 1934-35, as against Rs. 42,135 in the previous year.

SIND. During 1934-35 there were eleven *Taluka* Development Associations in Sind, of which seven did not function. A scheme for replacing these Associations by Rural Development Societies based on smaller and more homogeneous agricultural unit, was under consideration.

BENGAL. The activities of the District Agricultural Associations in Bengal were considerably limited during the period owing to the Government having stopped the grant to these bodies on account of financial stringency. With the exception of Naogaon, all the agricultural associations in the Northern Circle were in a moribund condition. In the Eastern Circle the Kishoreganj and Jaidebpur Associations are reported to have done useful work ; also some associations in the Western Circle. The Murshidabad District Agricultural Association established a dairy farm and distributed seeds and cuttings amongst its members. The Hooghly District Agricultural Association purchased seeds and cuttings to the value of Rs. 500 for distribution to members. The Howrah District Agricultural Association distributed paddy seeds and published a bimonthly agricultural journal. The Birbhum District Agricultural Association distributed sixty-six maunds of paddy seed, 20,000 Napier grass cuttings and forty tolas of tobacco seed in the District.

PUNJAB. The Agricultural Associations in the Districts of Jullundur, Hoshiarpur and Ludhiana were re-organised and the Tehsil Agricultural Associations were being established to work in co-operation with them. The question of amalgamating the Agricultural Associations with the District Rural Community Councils was under consideration.

BIHAR AND ORISSA. The Provincial Agricultural Association held its second meeting in August 1933 at the Kanke farm, and devoted itself mainly to a discussion of problems arising out of the protection given to the sugar industry. The Association's journal 'Kisan' was published as usual and continued to be popular.

ASSAM. During 1933-34 two Agricultural Associations were organized, one at Jorhat and the other in Dibrugarh, and a third one was formed at Karimganj in the next year.

NORTH-WEST FRONTIER PROVINCE. The Agricultural Association at Bannu continued to do useful work with the co-operation of the Agricultural Department.

5. Seed Multiplication and Distribution.

The substitution of improved seeds for the ordinary local mixtures provides one very important way by which cultivators can increase their income at but little cost to themselves. During these years of depression, agricultural departments have been making a special effort to increase the use of improved seed.

The Indian Central Cotton Committee continued its policy of assisting the Departments of Agriculture and Co-operative sale societies in the wider distribution of pure seed of improved varieties of cotton. The Committee has so far sanctioned sixteen seed extension schemes for the various cotton areas and thirteen of these are actually under operation —six in the Bombay Presidency, two in the Madras Presidency, one each in United Provinces, Central Provinces, Sind, Hyderabad and Baroda.

As in previous years, the Imperial Institute of Agricultural Research, Pusa, which is the birth place of many of the improved varieties now extensively cultivated in India, continued to supply pure seed of various crops for provincial departments of agriculture.

MADRAS. In this province the Department continued to pay special attention to paddy and cotton. It is noteworthy that the area under improved varieties of these crops has increased considerably. Improved strains of paddy to the extent of 1,677 tons during 1933-34 and 1,567 tons during 1934-35 were distributed, as against 280 tons in 1932-33. The total area under improved methods of planting paddy and economising seed is estimated at 950,000 acres. Under the seed extension scheme financed by the Indian Central Cotton Committee for the distribution of Co. 2 cotton in Salem and Coimbatore districts, the Department of Agriculture arranges every year a seed multiplication area of about 6,000 acres, while the Tiruppur Co-operative Trading Society has undertaken to gin pure all the seed-cotton obtained from the above area and distribute the seed to cultivators for about 100,000 acres. The

Department of Agriculture distributed during 1934-35 pure seed sufficient to cover an area of about 29,600 acres. Co-operative societies continued to be helpful in the distribution of improved strains of paddy, green manure, Cambodia cotton and in marketing agricultural produce.

BOMBAY. Special attention was given to cotton, for which there were in all six schemes for seed multiplication, financed by the Indian Central Cotton Committee. As stated in the previous Review, the first stage in each scheme is a small plot under the immediate charge of the plant-breeder who arranges that all plants are self-fertilized and there is no crossing with outside plants. In the second stage the self-fertilized seed is grown on large scale on a Government Farm and the seeds are kept free from contamination by other varieties. The next two or three stages are laid out in the lands of registered seed-growers who grow the seed according to instructions and permit the departmental officers to rogue the fields. The produce is collected and ginned separately and the pure seed obtained is stocked for the next season, the operations being managed with the help of co-operative societies, wherever possible. Under the Hubli and Athni Jayawant seed extension scheme, a total area of 310,662 acres was put down under pedigree Jayawant and Gadag No. 1 cottons during 1934-35 and 3,099,399 lbs. of pure seed were distributed in that year. Under the Khandesh seed extension scheme, which is in its fourth year, a total quantity of 1,641,614 lbs. of Banilla cotton, sufficient to cover 65,664 acres, has been purchased and stocked for general distribution for sowing in the 1935 season. Under the Deccan seed extension scheme, which is in the first year of its working, pure seed of Banilla sufficient for 1,000 acres has been distributed to registered seed-growers. Under the Surat seed extension scheme 1,118,908 lbs. of seed of 1,027 A. L. F. cotton were distributed during 1934-35.

Besides the above, the Department distributed during 1934-35 about 40,000 lbs. seeds of improved rice, about 224,000 lbs. of wheat, 20,980 lbs. of *jowar* and 1,600,000 setts of sugarcane.

SIND. The number of units of cotton seed multiplication has been revised to ten, seven of which are for medium long-stapled varieties and three for improved *deshi*. Under the Sind Cotton Extension Scheme financed by the Indian Central Cotton Committee, the Department of Agriculture organised during 1934-35 an area under pedigree seed of 2,710 acres and distributed 785,335 lbs. of pure seed in addition to 411,430 lbs. distributed by the Sind Provincial Co-operative Bank. A very important feature of the work on the left bank was the keen demand for 289 F-1 seed, not only in Thar Parkar where this cotton is extensively grown but also in Nawabshah and Hyderabad districts, where only *deshi* types were hitherto under cultivation. On the right bank the small area of twenty-five acres under cotton cultivation at the time of starting the scheme has increased to 4,000 acres and there is every prospect of this crop extending over a very large area. The total seed of all kinds distributed by the Department amounted to about 10,828 maunds in 1933-34 and 11,116 maunds in 1934-35.

BENGAL. The twenty District Agricultural Farms and a number of private farms run by zamindars and others continued to be valuable centres for the multiplication of departmental seeds and for the demonstration of improved methods. The scheme to establish paddy seed farms in Union Boards has proved successful and is being extended. In 1933-34, 295 seed centres, covering 2,774 acres, were organised and next year 334 seed centres covering 3,000 acres. Of these seed centres, ninety in 1933-34 and 136 in 1934-35 were under the management of Union Boards. The total quantity of seed supplied from these seed centres and from Government Farms amounted to 13,832 maunds in 1933-34.

UNITED PROVINCES. As the outcome of plot demonstrations, the active co-operation of the Irrigation Branch and the demands from Rural Development Centres, the demand for departmental seed had outstripped the supply. Steps were taken to create private or society sources of seed supply. Two lakhs thirty-four thousands six hundred and eighty-six maunds of seeds and 14 lakhs maunds of cane during 1933-34 and 254,117 maunds of seeds and 23 lakhs maunds of cane during 1934-35 were distributed, as compared with 252,263 maunds of seeds and 18 lakhs maunds of canes during 1932-33.

PUNJAB. The distribution of improved seed reached a higher level in 1934-35 in the Punjab than has ever been reached in previous years. One hundred thousand maunds of wheat, 55,000 maunds of cotton, 7,000 maunds of gram and 4,360 maunds of rice were the quantities of improved seed of these important crops which were given out to cultivators. The Punjab Government (Ministry of Agriculture) observes that if the yield from new wheat and cotton is placed at two maunds an acre above the old varieties and the premium from American cotton at Rs. two a maund and the increase of *gur* from new cane at thirty maunds to the acre, then the profit on the areas under improved seed undoubtedly runs to several crores of rupees each year. In order to enable the Department to carry out an extensive programme of seed distribution, the Punjab Government sanctioned additional district staff on the scale of one Agricultural Assistant and one *Mukaddam* per district.

BURMA. In the matter of seed distribution by far the most important item is paddy. The seed-supply for paddy amounted to 17,223,597 lbs. in 1934-35 and 13,260,751 lbs. in 1933-34 as against 11,560,409 lbs. in 1932-33. The increase was largely due to the fact that the grazing ground seed farm scheme came into full working order during the period. During 1934-35, 23 major seed farms covering a total area of 2,776 acres and 153 minor seed farms covering an area of 9,502 acres were at work, as against 22 major seed farms covering an area of 2,553 acres and 145 minor seed farms of 9,061 acres during 1933-34.

BIHAR AND ORISSA. The area under improved crops is now estimated at five lakhs of acres, of which 358,000 acres alone are under Coimbatore canes. The co-operative societies are taking an ever increasing interest in maintaining their own propaganda staff and financing the distribution of seed amongst their members.

CENTRAL PROVINCES. The number of seed farms were 18,843 in 1933-34 and 21,237 in 1934-35, as compared with 17,274 in 1932-33. The quantity of pure seed distributed was 464,834 maunds in 1933-34 and 431,804 in 1934-35, as against 445,413 maunds in 1932-33. The approximate area sown with improved seed was

1,693,812 acres in 1933-34 and 1,852,861 in 1934-35 as compared with 1,602,211 in 1932-33. The marketing arrangements for Verum cotton and for the extension, wherever possible, of medium and long staple cottons in short staple areas continued. The Department was able to distribute in the two years 2,013,312 lbs. and 2,429,616 lbs. of pure seed, sufficient to sow about 89,560 and 110,000 acres respectively and to handle through the departmental pool 5,087 bales in the first year at a premium varying from Rs. 24 to Rs. 45 over Broach and 5,750 bales in the second year at a premium varying from Rs. 13 to Rs. 90 over Broach.

ASSAM. The total seed distribution amounted to 2·8 lakhs of lbs. of improved seeds, and 74,228 cane setts during 1933-34. During 1934-35, 3 lakhs lbs. of improved seeds and 116,355 cane setts were issued.

MYSORE. The number of seed farms for *ragi* was increased and 49,076 seers of pure seed were supplied. The distribution of selection 69 cotton seed in the Chitaldrug District was continued and 3,139 maunds of pure seed were distributed. The organization of the co-operative sale of the selection 69 cotton was continued and 995 maunds of lint were sold in the year, fetching a premium of Rs. 3 to Rs. 6 per *naga*. Sugarcane H. M. 320 continued to be the most popular variety and gained a firm footing in the Irwin Canal tract and in practically every cane-growing tract in the State.

HYDERABAD. The Hyderabad seed extension scheme, which is financed by the Indian Central Cotton Committee, came into operation in March 1930, the total area sown to Jayawant and Upland improved varieties being 24,000 acres in 1933-34 and 6,370 acres in 1934-35. In the Nanded District, Gaorani seed sufficient for an area of about 73,090 acres was distributed during 1934-35. In the Aurangabad District seed of Banilla sufficient for about 9,000 acres was distributed. In the Parbhani District improved seed of Verum 262 sufficient for an area of 1,550 acres was distributed. In the Raichur District, seed of Jayawant sufficient for about 29,551 acres and seed of Upland Gadag 1 for about 3,471 acres was distributed.

BARODA. In the Navsari District a controlled seed distribution scheme was put in working with the help of a grant from the Indian Central Cotton Committee. Three thousand four hundred and twenty lbs. of pure 1,027 A. L. F. were distributed during 1933-34; in addition, 109,760 lbs. of seed were distributed through seed depôts. Owing to the severe damage to cotton on account of frost during 1934-35 arrangements for large quantities of good cotton seed had to be made and 955,580 lbs. of cotton seed were distributed through twelve seed depôts. Seven of these were financed by the Indian Central Cotton Committee. In the Baroda District the Department distributed during 1933-34 1,289 lbs. of Broach 9 cotton. During 1934-35 seed sufficient for 8,000 acres was distributed. In the Mehsana District the Department supplied 6,000 lbs. and 2,100 lbs. respectively of Wagad 8 during the two years. In the Amreli District 15,000 lbs. and 57,930 lbs. of Dhulia 1 were distributed during the two years under review.

TRAVANCORE. The total quantity of selected seeds of paddy distributed by the Department was 33,514 lbs. during 1933-34 and 40,002 lbs. during 1934-35. From the Alwaye Farm 18,100 setts of new varieties of sugarcane were distributed in 1934-35. The Coconut Farms at Alleppey, Oachira and Trivandrum continued to raise seedlings for sale to the public.

COCHIN. A system of registered seed-growers has been organised in this State; Nine hundred and eighty-five paras* of seeds were issued to 197 persons during 1934-35 as against 740 to 148 persons of the previous year. Over 120 acres were sown with the departmental varieties.

6. Implements.

In Appendix V will be found a statement of the agricultural implements sold through Departmental Agency. The recorded sales are no real measure of the extent to which improved implements have come into use. Both manufacture and sale by private agencies is increasing and departmental sales in some provinces represent little more than the first following up of successful demonstrations. The total sales of all agricultural implements amounted to 51,803 in 1933-34 and 63,766 in 1934-35, as compared with 67,354 in 1932-33. The number of ploughs sold declined from 17,183 in 1932-33 to 16,381 in 1933-34 and then rose to 20,659 in 1934-35. Sales of fodder-cutters increased from 20,281 in 1932-33 to 23,094 in 1933-34 and 28,264 in 1934-35. Sales of cane-mills decreased from 6,368 in 1932-33 to 2,910 in 1933-34 and 4,377 in 1934-35. A satisfactory feature is the increase in the number of spare parts sold.

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* 1 para=about 8½ Madras Measures.

MADRAS. The total number of demonstrations conducted by the Department with different kinds of improved implements, like light iron ploughs, etc., was 9,585 during 1933-34 and 12,111 in 1934-35 as against 6,800 in the previous year. The number of ploughs supplied during 1933-34 was double that of the previous year, the increase being attributed to a large number of *takavi* loans granted to ryots.

SIND. It is reported that a large number of private firms manufacture and sell direct to cultivators the cheaper types of improved agricultural implements originally introduced by the Department. Considerable success attended the introduction of a new type of clod-crusher—Jenkin's clod-crusher—designed by the Cotton Breeder and Farm Manager, Mirpurkhas. A cheap and serviceable inter-cultivator designed at the above farm was popular and local *mistries* are reported to have undertaken their manufacture. The increased area of wheat and cotton in the Barrage areas has emphasised the importance of a cheap and effective drill for sowing these crops and of machinery for dealing with them after harvest. A full-time Agricultural Engineer is being appointed to concentrate work on the designing and manufacture of suitable types of improved implements.

BENGAL. The 'Sobkham' ploughs designed by the Agricultural Engineer are reported to be increasing in popularity, their cost being well within the buying capacity of the cultivators.

UNITED PROVINCES. The Department has established the Gurjar plough (the well known Meston plough) as the standard type and these ploughs are now available in the province at Rs. 5-8-0.

Other implements which have been standardised are the Akola hoe for intercultivation, and disc threshers for straw crops. The sale of implements and parts increased from 14,127 in 1932-33 to 14,515 in 1933-34 and 18,047 in 1934-35. Tractor ploughing for the eradication of *kans* (*Saccharum spontaneum*) in Bundelkhand has proved a sound economic proposition.

PUNJAB. The Department of Agriculture sold 33,800 implements and spares during 1933-34 and 40,000 in 1934-35 as against 36,150 in 1932-33; chaff-cutters to the extent of 21,750 and 26,000 respectively were sold during the two years under review. An encouraging feature was the manufacture by local blacksmiths of simple implements, such as improved hoes and harrows.

BURMA. The Department distributed 4,893 plough-shares in 1933-34 and 4,769 in 1934-35, as against 3,846 in 1932-33. The manufacture of *theikpan* plough-share, introduced by the Department, was increasingly undertaken by local blacksmiths.

BIHAR AND ORISSA. The implements designed by Messrs. Cliff and Sarkar of the Bihar and Orissa Agricultural Department and known as the ‘ Bihar ’ and ‘ Sukhada ’ implements respectively were very popular. The demand for *rahat* (Persian wheel), supplied by the Engineering Section of the Department, continued to be satisfactory.

CENTRAL PROVINCES. Improved implements to the extent of 25,412 valued at about Rs. 1,60,000 were issued during 1933-34 and 35,659 implements valued at about Rs. 1,90,000 in 1934-35, as compared with 21,980 valued at Rs. 1,70,000 in 1932-33. The value of three-roller sugarcane mill and iron *gur*-boiling pans was appreciated by many private firms dealing in these appliances. Iron ploughs and garden tools were not in demand on account of the poor condition of draught animals as well as trade depression. The McGlashan furnace introduced by the department for making *gur* was becoming popular.

ASSAM. The superiority of three-roller sugarcane mills is being increasingly appreciated by all sugarcane growers and the business is in the hands of private traders. The McGlashan furnace was tried in several places with success.

NORTH-WEST FRONTIER PROVINCE. The number of demonstrations with modern implements was 156 in Bannu and 143 in Dera Ismail Khan during 1933-34, as against sixty-four and twenty-three respectively of the previous year. *Taccavi* grants were given for the purchase of three-roller cane crusher.

In MYSORE owing to the prevailing economic depression, the number of improved ploughs sold during 1933-34 fell to 758 from 1,657 in the previous year. The value of the implements sold was Rs. 43,000 as against Rs. 46,000 during 1932-33. A gratifying feature of the year's work was the improved quality ploughs, locally manufactured.

TRAVANCORE. The Department paid special attention to the popularization of light iron ploughs. The Meston and Climax ploughs were found to be well adapted to local conditions and efforts were made to popularise their use. Amongst the local manufacture of Mould-Board Ploughs, 'pallikkal' plough has been most successful. The three-roller sugarcane mill was becoming popular.

COCHIN. Demonstrations in ploughing with light iron ploughs were conducted wherever possible. There was demand for spraying machines, hand-forks and rubber hoses.

BHOPAL. Tractor ploughing on heavily infested *kans* (*Saccharum spontaneum*) areas to a depth of 12-14 inches was done on an area of 2,150 acres at a cost of Rs. 4-8-0 per acre on heavy black cotton soil. Various inexpensive and new implements previously not used in the State were introduced from the Central Provinces and the Punjab.

7. Fertilizers.

The table in Appendix VI gives the ascertained sales by agricultural departments' depôts. Sales by private agency too have always been important. Imports of fertilizers including ammonium sulphate totalled 49,546 tons in 1933-34 and 66,481 tons in 1934-35 compared to 52,676 tons in 1932-33. Indian production of ammonium sulphate amounted to 8,691 tons in 1933-34 and 13,751 tons in 1934-35 and approximate consumption of ammonium sulphate to 36,370 tons in 1933-34 and 51,573 in 1934-35 as compared to 46,783 tons in 1932-33.

MADRAS. Better methods of preservation of farmyard manure with a view to increase its quality and quantity formed one of the important items of propaganda work. The manufacture of compost and poudrette with rubbish and night-soil was demonstrated wherever possible. The system of growing green manure crops like *dhaincha* (*Sesbania aculeata*), sunnhemp and wild indigo was increasing. The quantity of green manure seed distributed by the Department amounted to 211 tons in 1933-34 and 314 tons in 1934-35. Ammonium sulphate was in demand for application to paddy and sugarcane crops. In the Nilgiri district 322 tons of artificial manures were sold to potato growers during 1934-35.

BOMBAY. Sulphate of ammonia, which is now cheaper than what is used to be, is reported to be used increasingly for irrigated crops. The provision of irrigation water to encourage the utilization of sunnhemp for green manuring continued as a concession on the Nira right bank canal.

SIND. Investigations into the methods of manufacturing compost have been in progress for the last three years. An improved method of composting has been evolved by the Department which besides giving manure of superior quality is appreciably cheaper and more simple than composting in pits. This is being increasingly demonstrated. In order to encourage the cultivation of crops for green manuring, the Government have allowed certain concessions during both the *adhawa* and *rabi* seasons.

BENGAL. There was ready demand for the departmental mixture of cake and fertilizer for use on the cane crop ; 25,000 maunds of this were sold during 1934-35.

UNITED PROVINCES. The quantity of manures distributed by Departmental Agency increased from 78,551 maunds of manures in 1933-34 to 89,541 maunds in 1934-35. The sale by the Imperial Chemical Industries (India) Ltd. rose from 22,000 maunds in 1932-33 to 32,000 maunds in 1933-34 and 60,000 maunds in 1934-35. The number of demonstrations with green manuring in cultivators' fields totalled 1,984 in 1933-34 and 1,864 in 1934-35.

PUNJAB. Intensive propaganda carried out by the Department for the proper storage of the farmyard manure and preparation of compost has resulted in several thousands of manure pits being dug by zamindars.

BURMA. The use of fertilizers such as bonemeal, ammonium sulphate and the ammonium phosphate, particularly in parts of the Delta, has become an established practice. The principal firms engaged in the trade sold about 440 tons in 1933-34 and 692 tons in 1934-35, as compared with 200 tons in 1932-33.

BIHAR AND ORISSA. Wide-spread campaign of green-manuring uplands with sunnhemp and lowlands with *dhaincha* (*Sesbania aculeata*) was undertaken and demonstration parties went round showing the cultivators how the manure was to be ploughed into the soil and what subsequent operations were necessary. Methods of making compost from village waste without any cost were demonstrated. 15,000 maunds of fertilizers were sold during 1934-35. In addition to this, it was ascertained that in the South Bihar Range alone 29,700 maunds of fertilizers worth Rs 1·1 lakh were sold by non-departmental agencies.

CENTRAL PROVINCES. The demand for artificial and oil-cake manures, mostly for sugarcane, is steadily increasing, as a result of demonstrations. In the Southern circle alone 2,388 maunds of sulphate of ammonia, 154 maunds of Niciphos and 2,388 maunds of oil-cake were sold.

ASSAM. The Department paid more attention to the utilization of natural manures available locally, particularly on the proper use of cow-dung and the use of water-hyacinth (*Eichhornia crassipes*). Four hundred and seventy-six pits were erected by the cultivators at the instance of the Department during 1934-35.

NORTH-WEST FRONTIER PROVINCE. At Tarnab Agricultural Station, the Indore process of composting vegetative waste for use as manure has been introduced. The activities of the Department were directed to the preparation of artificial manure using locally-made saltpetre and bone disintegrated by roasting, charring or other means.

MYSORE. The sale of artificial manures for money crops such as coffee, cardamom and sugar has shown a marked increase. Owing to the low prices for paddy, it did not pay to use artificial manures for this crop.

TRAVANCORE. During 1934-35 seventy-eight manurial demonstrations on paddy and 123 demonstrations on coconuts were conducted in different parts of the State. Many individuals and private firms have established manure depôts in the State and sold manures to the value of about Rs. 50,000 during 1934-35.

COCHIN. Permanent manurial experiments on double cropped paddy lands showed that the plots receiving organic manures continued to give the best results. *Tephrosia candida* continued to be one of the best of green manure crops. About 94,695 lbs. of manures valued at about Rs. 2,373 were sold through the Department.

CHAPTER VII.

AGRICULTURAL EDUCATION.

1. Agricultural Colleges.

MADRAS. The Coimbatore Agricultural College received 139 applications for admission as compared to 180 in the previous year and 321 in 1931-32. The final strength of class I was of forty students, of whom one resigned at the end of the second term. The reduced chances in recent years of employment under Government for graduates in agriculture accounted for the decreasing demand for admission. Under the old regulation, for the B.Sc. (Ag.) degree forty-six students appeared for examination in Part I and 37 passed, while in Part II fifty-one appeared and forty-eight passed; under the new regulations forty-four appeared for the first examination and thirty-two passed. With effect from the academic year 1934-35, the Madras Government sanctioned the institution of a course of instruction in co-operation, auditing, book-keeping and banking at the Agricultural College, Coimbatore, to enable the students of the college to qualify for appointment as Inspectors in the Co-operative Department.

In 1934-35 applications for admission numbered ninety-one and the final strength of Class I was thirty-one. All the five students who appeared for examination in Part I under the old regulation passed; in Part II, thirty-nine out of forty-one passed. Of the forty-five and thirty-two students who appeared for the first and second examinations under the new regulations, thirty-nine and twenty-six respectively passed.

BOMBAY. The Poona Agricultural College celebrated its Silver Jubilee in 1933-34. Sixty students were admitted as against forty-five in the previous year. The old degree of Bachelor of Agriculture (B. Ag.), granted by the University of Bombay to students of the Poona College of Agriculture, has been replaced by the B.Sc. (Ag.) and the course has been considerably amended and improved. The new curriculum came into force from June 1934. In order to assist students to obtain suitable employments, the

Poona Agricultural Graduates' Employment Bureau was formed with the Principal of the College as *ex*-officio president.

In 1934-35, in spite of the increase in fees, there was a rush for admission to the Poona Agricultural College and eighty-five students were admitted as against sixty in the previous year. Two post-graduate students obtained the degree of M. Ag. during the year.

UNITED PROVINCES. The Agricultural College, Cawnpore, provides a four-year course leading to the Bachelor's degree in Agricultural Science of the Agra University. There were ninety-five applications for admission of which sixty-one were admitted for 1st and 3rd year classes. The total number of students on the roll at the end of the year was 156. Thirty-eight students appeared for the final B.Sc. (Ag.) examination, of whom thirty-six passed. Two of them passed in the first division and two obtained distinction in chemistry.

During 1934-35 the total number of students in the college was 166. Thirty-five students appeared for the B.Sc. (Agri.) examination and twenty-nine passed.

THE PUNJAB AGRICULTURAL COLLEGE, LYALLPUR, received ninety-eight applications for admission in 1933-34 as compared to seventy-six last year. Eighty-one students were admitted as against fifty-nine of the previous year. To encourage the admission of sons of farmers, payment of fees on monthly basis, instead of for a quarter was sanctioned as an experimental measure for one year. The total number of students in the College was 378 in 1933-34 as against 362 in the previous year. Under the old regulations one student appeared for the final examination and passed. Of the thirty-six students who appeared for the Degree of B.Sc. (Agri.), twenty-nine passed.

The Punjab Government sanctioned the institution of a post-graduate course in sugar chemistry. Six students were admitted during the year. A three months' course was given at Lyallpur in the chemistry of sugarcane and sugar products. This was followed by a three months' course of sugar manufacture by the open pan system at the Jullundur Experimental Station. Only two men joined the latter course and only one completed it.

The year (1934-35) witnessed the completion of the 25th year of the Lyallpur Agricultural College. Starting in 1909 with a single three-year diploma course and with only sixteen students, it now provides courses for the M.Sc. (Agri.) and B.Sc. (Ag.) degrees of the Punjab University, the Leaving Certificate, the Teachers' Class, the Vernacular Class and upwards of a dozen other specialized classes for agricultural and allied subjects. Four hundred and eight students passed through various classes during the year. Candidates for the degrees numbered 137 as against ninety-eight in the previous year; eighty-eight students were admitted to the first year class and seventy-seven only joined. Two students obtained the M.Sc. (Ag.) degree during the year. Of the thirty-one students who appeared for Part II of the B.Sc. (Ag.), sixteen were successful in all subjects. Of the twenty-nine students who appeared for Part I of the final examination, twenty-one were successful. The college enjoyed the unique position amongst colleges affiliated to the Punjab University of providing the greatest number of recruits for the University Training Corps. Of the 162 students in the degree classes, 143 were members of the corps.

In 1933-34 the NAGPUR AGRICULTURAL COLLEGE received sixty-five applications for admission to the first year of the Degree Course, of whom thirty-seven were admitted and thirty-one finished the year. Nineteen students, plus three compartmentals, appeared for the B.Ag. degree examination and nineteen qualified.

In 1934-35 applications for admission to the college numbered seventy-four, of whom forty-four were selected. The final strength of the first year class was thirty-eight. Of thirty-five students, including two compartmentals, who appeared for the B.Ag. degree twenty-six passed. A vernacular course in dairying was held during the year and eleven students attended the course. Under the M.Ag. ordinance passed by the Nagpur University towards the year, a candidate for the degree of Master of Agriculture has to submit published papers approved by the Faculty of Agriculture or a thesis embodying the results of his own research.

BURMA. As a measure of retrenchment, the teaching side of the Agricultural College at Mandalay was suspended indefinitely with effect from April 1933. The College remained closed to students throughout the year 1934-35.

THE HEBBAL AGRICULTURAL SCHOOL, MYSORE STATE, continued to be popular and the pressure for admission into the school increased. The school had a total strength of ninety-one. There were 199 applications for the first year class and thirty-six were selected. Thirty students appeared for the Diploma examination and fourteen students passed, of whom four secured distinction.

In 1934-35 the Hebbal Agricultural School completed another successful year. Thirty-eight students appeared for the final examination and sixteen were declared eligible for the Diploma and one of them passed with distinction. The number of applications for admission into the first year class was sixty-two, against 199 during 1933-34, the fall being due to the higher entrance qualification required.

2. Post-graduate Training in Agriculture.

At the Imperial Institute of Agricultural Research, Pusa, one student in Botany completed the two years' post-graduate work in 1934. In the same year three students completed one year's training in farm organisation, farm management and general farm engineering. Of twenty-four candidates for admission to the new session commencing 1st November 1933, eight were selected—four in Botany, two in Chemistry, one in Entomology and one in General Agriculture. Fifteen students qualified for the award of the Indian Dairy Diploma and a new class with twenty-one students was opened in October 1933. Three post-graduate students were admitted to the fifteen-month course in Animal Husbandry, Animal Nutrition and Dairying. A batch of fifteen British soldiers was admitted to the Bangalore Dairy Farm for a six months' vocational course in practical dairying but only eleven remained for the full period. Another batch of fifteen soldiers was also admitted for a similar course. A special course in flue-curing of tobacco at Pusa, which was attended by nine students, was cut short as a severe hail storm ruined the tobacco crop and the earthquake of 15th January 1934 damaged the flue-curing barn.

There were thirty-two candidates for admission to the post-graduate course beginning in November 1934, of whom seventeen were recommended by provincial authorities. Thirteen applicants were selected for admission—three in Botany, five in Agricultural Chemistry (of whom one left for England to specialize in animal nutrition), one in Entomology, one in Mycology and three in General Agriculture. During 1934-35 ten post-graduate students completed two-year courses :—five in Botany, one in Chemistry, one in Entomology and three in Sugarcane breeding. The one-year course in farm organisation, farm management and general farm engineering was completed by one student.

The fifteen-month post-graduate course in Animal Husbandry, Animal Nutrition and Dairying was completed by three students in April 1935. Of the two students admitted in the new session beginning on 2nd January 1935, one left for Scotland for higher studies.

A class of twenty-one Indian Dairy Diploma students was started in November 1933. One student left and one more was admitted for a repetition course. No admissions were made during 1934 since admissions are made alternately at Bangalore and at the Allahabad Agricultural Institute. Five students were considered fit for the award of the Indian Dairy Diploma at an examination held at the Allahabad Agricultural Institute.

A number of students and post-graduate workers were also admitted for varying periods in various sections. The group of fifteen British soldiers and another of twelve, completed at the Bangalore dairy a six months' vocational course in practical dairying. A third group of thirteen, admitted in April 1935, was under training at the close of the year. A special course in flue-curing of tobacco lasting for two months was organised at Pusa and although there were a number of applicants, for want of accommodation, only ten students could be admitted to it.

Post-graduate training in Agricultural Meteorology. The Agricultural Meteorology Section at Poona attracted a number of research students. Six of them were working on different problems. The loyal and enthusiastic co-operation of these workers was responsible for the progress being made on many problems, work on which could not have been undertaken but for their assistance.

3. Agricultural Schools.

MADRAS. The Agricultural Middle School at Usilampatti, which continued to be under the management of the District Board, Madura, contained thirty-nine students during 1933-34 and thirty-two students during 1934-35. The Vocational Middle School at Muthanandal maintained by the Ramnad District Board, imparted agricultural education to sixty students during 1933-34 and was closed early in 1934-35. As there was no likelihood of the proposal for an Agricultural Middle School at Kalahasti materializing, the question of running the farm as an experimental station without a school was under consideration. The three Farm Labourers' Schools at Anakapalli, Palur and Coimbatore imparted education to seventy-seven day and thirty-five night students during 1934-35.

The two Vernacular Agricultural Schools at Devi-Hosur and Dhulia in BOMBAY continued to do good work. The curriculum of the schools was changed. The 3R's (reading, writing and arithmetic), sanitation, civics and geography were omitted and only agriculture, botany and co-operation were retained. The school at Devi-Hosur, which is the only agricultural vocational school in the whole of Karnatak, has been in existence for twenty-one years. Fifteen students were admitted and fourteen completed the year. The results of the annual examination were satisfactory. Thirteen students out of fourteen in the first year and eight out of twelve in the second year passed. The number of past students was 263 of whom 137 students took to private farming. The school at Dhulia is the only Agricultural Vocational School in the whole of Maharashtra and has been in existence for twelve years. Poultry is the special feature of the school. Out of 125 students turned out by the school up to now, forty-two have taken to private agriculture, sixty-three have been engaged on propaganda work with Taluk Development Associations and the like.

At the Bulandshahr Agricultural School in the UNITED PROVINCES fifty-one students were under training for the two-year

Diploma course during 1933-34. Twenty-seven students appeared in the Diploma examination of whom twenty-six passed. All the eight students of the Fieldman course and thirteen of the Farm Mechanic course were awarded certificates. Thirty-five new students were admitted in the first year. To inaugurate an intensive rural campaign, special training in agriculture along with other subjects of rural importance for a number of village school-masters was proposed to be undertaken in the school in the coming year. At the Agricultural School, Gorakhpur, there were fifty-four students on the roll during the year of whom forty-eight were in the two-year Diploma course and six in the final Fieldman class, all of whom passed. Twenty-five applications were received for admission to the Diploma class and eight to the Fieldman class.

At the Bulandshahr Agricultural School during 1934-35 there were forty-nine students for the Diploma course, four for the Fieldman class and nine for the Farm Mechanics class. All the twenty-four students who appeared for the Diploma examination passed. The school trained sixty village school teachers and twenty-two cane supervisors during the year. Sixty men for the rural development were under training. At the Agricultural School, Gorakhpur, forty students were in the Diploma course and four in Fieldman course. All the twenty-five students who appeared for the Diploma examination passed.

CENTRAL PROVINCES. At the Powarkheda Agricultural School during 1933-34 the total number of students in all the classes was ninety of whom nine left during the course of the year. Twelve boys were sent up for the High School Scholarship and Entrance Examination and passed. At the Peace Memorial School, Buldana, sixty applications were received for admission into the first class, of which twenty were selected and fourteen joined the course. All the boys received stipends. The management of the Anglo-Vernacular Agricultural Middle School, Betul, added one more English teacher trained in agriculture during the year.

The Agricultural School at Powarkheda began the year (1934-35) with sixty-six boys on the roll. The final strength of the school was eighty-five as against eighty-one of the previous year. Under the will of the late Seth Nanelal of Hoshangabad, the village of Powarkheda was bequeathed to the school under certain conditions, which were under discussion with the executors. If the gift is accepted, the school will have great opportunities of instructing pupils in village uplift. The Peace Memorial Agricultural School at Buldana, which was opened with the object of giving a practical training in improved methods of agriculture to sons of agriculturists seeking admission, admitted eighteen students. Many of them seeking admission were attracted by stipends which the fund provided and sought service on completion of their training. The Anglo-Vernacular Agricultural Middle School, Betul, imparted training in practical agriculture and horticulture to fifty-four students.

The American Baptist Mission Agricultural School at Pyinmana in BURMA provided a mixed literary and agricultural education to Middle School boys. Twenty officers of the agricultural and three of the veterinary department were given a special course of training in accounts, general administration and land records and surveying during August-September 1933. At the Hmawbi Farmer School ten students received a course of nine months training in horticulture and at the Mahlain Farm School twelve students were trained in general agriculture with special reference to the improved methods of cultivation which the department was demonstrating in connection with the grant from the Indian Central Cotton Committee.

MYSORE. The three Vernacular Agricultural Schools at Chikkanahally, Ramakrishnapur and Hassan had successful years. The last named institution was under the management of the Hassan District Board. The performance of the students of the Ramakrishnapur was particularly good. All the eleven students who appeared for the final examination passed, one of them heading the list of successful candidates from all the three schools in the State.

TRAVANCORE. The Agricultural Department maintains two agricultural schools, one at Koni and the other at Kottarakara. The course extends over two years and it is so arranged that the classes in each school start in alternate years. A fresh batch of students may therefore be admitted to one of the schools every year. At the Agricultural School, Kottarakara, nineteen students were on the roll at the end of 1933-34 as against eighteen during 1934-35. At the Koni Agricultural School, there were twenty-eight students on the roll at the end of 1933-34 as against thirty during 1934-35. At the Agricultural School, Parassala, which is a private institution and managed by the people of the locality with the aid of a Government grant, eight out of the nineteen students in the first batch came out successful in the final examination. A second batch of eighteen students was under training during 1933-34.

4. 'Rural Bias' Schools.

Anglo-vernacular Schools in the various provinces teach agricultural classes. In the Bombay, Bengal, United Provinces and the Punjab arrangements are made to train teachers in this subject.

In the BOMBAY PRESIDENCY proper the Agricultural Bias Classes were started more than a decade ago. In 1933-34 there were ninety-two Agricultural Bias Classes of which seventy-nine were managed by the District Local Boards and the remaining by different mission societies and other private bodies. The schools continued to do good work.

The Secondary Agricultural School at the Dacca Farm in BENGAL continued its good work during 1933-34. A batch of teachers received the Certificate course in preparation for their work as teachers in the High and Middle English Schools with an agricultural bias. Fifty-one schools (twenty-five High English Schools and twenty-six Middle English Schools) in Bengal participated in the scheme introduced in 1927 for instruction in agriculture in High English and Middle English Schools during 1934-35. Three thousand eighty-four students received instruction and the area under cultivation being 216 acres. At the Dacca Secondary Agricultural School fourteen students appeared for the final examination of whom thirteen passed. Sixteen students were admitted to the 1st year class in January 1935. The District Board showed an increased interest in agricultural education.

In the UNITED PROVINCES the department maintained close touch with the non-departmental institutions of the province and the Vernacular Middle Schools in which agricultural classes were held. Special training was given at Partabgarh, Bulandshahr and Gorakhpur Agricultural Schools to village school teachers to equip them for rural development work. Some sixty village teachers received training at Partabgarh in rural uplift work during 1934-35.

In the Agricultural College, Lyallpur, seventy-eight students were admitted for the Vernacular Classes and sixty-one passed the final examination. So keen was the demand for admission that it was found necessary to revive the class at Gurdaspur. Formerly twenty-five to thirty Vernacular Certificated teachers were admitted annually to the Teachers' Training Class but owing to the inabilities of District Boards, under whom these teachers work, to finance the opening of small school farms and school gardens, the number admitted to the course was restricted to twelve two years ago. The whole course of instruction was remodelled and it has been decided to increase the admission to this class to thirty annually.

5. Short Courses.

Short courses in special subjects are given at various agricultural institutions and demonstration farms.

The Madras Government sanctioned the opening of short courses of ten subjects in practical agriculture to meet the needs of young men who could not undergo the University course in agriculture. Only one course on Farm Management was given to eleven students during 1933-34. During 1934-35, thirteen students attended the course in Farm Management. In addition sixty-seven students were given short courses of instruction in malt-making, bee-keeping, jaggery-making and insect-pests and diseases during the year.

In Bombay the Horticulturist to Government runs a yearly course on all branches of horticulture at the Ganeshkind Fruit Experiment Station. Special classes in sugar-making by the open-pan process, etc., were given by the various Deputy Directors or Specialist Officers of the Department. During 1934-35 special courses were given to thirty students in the college, fifteen being trained in oil engines and pumps, six in horticulture, six in poultry, two in dairying and one in agricultural chemistry. The Horticulturist to the Government held five classes in horticulture in the district. In addition the various Deputy Directors of Agriculture held horticultural classes. In the South Central Division fifty-eight classes were held for a period of two to three days on fruit culture, land development and irrigation farming.

In the PUNJAB short courses on fruit culture and fruit and vegetable preservation continued to be popular. Out of 270 applications received for admission to the course held in July 1933, seventy were admitted. Sixteen agricultural assistants from various circles were given a course of training in such subsidiary cottage industries as sericulture and lac culture.

At the Mudon Agricultural Station in BURMA a short course of one month in general agriculture was given to eighteen and fifteen students respectively during the two years. In addition a short course of special instruction was given on the manufacture of arrowroot and tapioca flour.

In BIHAR AND ORISSA the Central Farms continued to train their own overseers and *kamdars**. Special facilities were provided in the Research Stations to honorary research workers and other persons for specialised training in any particular branch. Rules were drawn up for the practical training of private persons on the Departmental Farms, and Range Officers were authorised to admit suitable applicants for practical training at their farms.

6. Adult Education.

In the eastern circle of the UNITED PROVINCES there were fifty-five Adult Schools. In the Sarda Circle the Adult Education Co-operative Society worked at ten centres during 1934-35. The chief aim of these schools is to make the cultivator better fitted to adopt new improvements in the methods of agriculture. Adult schools continue from two to three years after which they are converted into village reading clubs.

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* Farm trained labourers for propaganda work.

CHAPTER VIII.

THE CO-OPERATIVE MOVEMENT AS AFFECTING AGRICULTURE.

During a period of general economic depression it was but to be expected that the co-operative movement should also show signs of tension, stagnation and even deterioration at some points. If, therefore, there are no striking achievements to be recorded in the sphere of co-operation during the period under review, it is a matter for some satisfaction that the movement has been able to withstand the unprecedented strain as a result of the catastrophic fall in prices of agricultural produce and has on the whole emerged without a serious *débacle*. The Royal Commission on Agriculture rightly said that " if co-operation fails, there will fail the best hope of rural India ". If the credit aspect still looms large in the co-operative movement, it is because, the principal problem of India is the organisation of village farming on a more rational and efficient basis. It has rightly been observed that the " modern conception of the co-operative movement differs markedly on that commonly held at the close of the last century ; the term agricultural organisation, or better still rural reconstruction, expresses more accurately the nature of the activities included within the movement." The rural problem has to be attacked as a whole and at all points simultaneously. A whole generation has passed since the co-operative movement was first initiated by the passing of the Co-operative Credit Societies Act of 1904 and it is not at all surprising that at a time of acute agricultural depression the defects and the weaknesses of the movement should be seen in bolder relief than in happier and more prosperous times. Circumstances have been against the development of other forms of co-operative activities, for the agriculturist has found it increasingly difficult to maintain his standard of living and to meet his cash liabilities at a time when his saleable goods have been declining in value. It is a striking testimony, however, to its inherent stability that despite an unprecedented crisis of world-wide intensity, the solvency of the movement as a whole has never been threatened. More than ever is it being felt that through co-operation alone, not in the narrow sense of merely providing financial facilities to the agriculturist, but in the wider sense of integrating and improving the life of the village as a whole that the solvent is to be found for India's poverty.

In the previous review an account has already been given of the All-India Conference of Registrars of Co-operative Societies which met in January 1934 with the Hon'ble Sir Fazl-i-Husain as President. The resolutions passed at the Conference have already been reproduced *in extenso* on pages 287 to 291 of the Review of Agricultural Operations in India for 1931-33. There was a certain amount of discussion in connection with Resolution No. 5, urging the necessity for all-India legislation for the registration of co-operative societies, the operations of which extended all over India or more than one province. Opinion was sharply divided at the Conference and it was ultimately decided to leave the matter to the discretion of the Local Governments to take such action as was considered necessary for their individual requirements.

The financial position of the Co-operative movement came to be discussed at the Provincial Economic Conference which was convened by the Government of India in April 1934. It was felt that if the Rural Department of the Reserve Bank of India was to function effectively with reference to the agricultural requirements of the country, steps would have to be taken to link up the activities of the Bank with those of the co-operative movement in the provinces. Mr. M. L. Darling, C.I.E., I.C.S., was placed on special duty to investigate the problem and to suggest measures which should be adopted with a view to supply credit facilities to agriculturists and land-owning classes in collaboration with co-operative banks and other similar institutions. As a result of Mr. Darling's recommendations and with a view to assist the provinces to develop the movement on a sound financial basis, a sum of Rs. 15 lakhs has been allotted to the provinces by the Government of India out of the grant of Rs. one crore set aside for rural development. The objects of this special allotment are as follows :—

(*a*) to train the existing staff, official and non-official, employed in the various provinces, and (*b*) to educate the members of Co-operative societies, more especially the office-bearers and members of Committees in their bye-laws and in the elementary principles of co-operation.

The grant was allocated to the provinces on the basis of membership of primary societies and was expected to enable the Local Governments to help the movement to develop on proper lines.

Some detailed figures are furnished below regarding the state of the co-operative movement in the various provinces.

PUNJAB. This is perhaps the only province where the co-operative movement showed signs of vitality and even of progress. The number of AGRICULTURAL SOCIETIES increased from 17,726 to 18,215. CREDIT SOCIETIES formed the majority of these institutions and increased their membership from 484,000 in 1932-33 to 493,000 at the end of 1934-35 with increased capital of 836·7 lakhs as compared with 811 lakhs in the previous year. Advances by societies to the members showed also substantial expansion and amounted to 186·81 lakhs in 1934-35 as against 159 lakhs advanced in the previous two years. The purpose of the loans continues to be as before, chiefly repayment of debts, purchase of cattle, payment of revenue, trade and expenses incurred in connection with purchase of land, building of houses, celebration of marriages and other rites incidental to the exigencies of social life. The Indebtedness Relief Legislation passed in 1934 and the threat of similar legislation in future restricted the supply of agricultural credit so far as it was provided by money-lenders. Realisations also showed signs of improvement from thirteen to fifteen per cent.

CONSOLIDATION OF HOLDINGS continues to be one of the principal activities of the Department and the number of societies rose in 1934-35 to 121 as against 101 in 1932-33 and the area consolidated amounted to 63,534 acres, the cost of consolidation being Rs. 1-11-8 per acre. Substantial results have been achieved from this movement, as, for instance, a large area in one village has been drained and seventy miles of village road have been improved and straightened in the Jullundur district, while 617 acres of waste land have been converted into well-irrigated areas in the same district and 663 acres of uncultivated land brought under the plough.

Co-operative commission shops decreased from twenty-three to twenty-one, the set-back being apparently the result of a large number of defalcation cases involving a sum of Rs. 50,000 which was detected in 1932-33. The Okara Sales Society, one of the successful organisations of this type, sold produce valued at Rs. 12¼ lakhs in 1933-34 as compared to nine lakhs in the preceding year. Of the two Unions and seventeen Societies for the purchase and sale, only those under the close supervision in Criminal Tribe Settlement and Reformatory Farm area functioned successfully. The Crop Failure Relief Societies in Dusuya Tehsil, which now number 74, continued to make small collections of grain and thus kept alive the spirit of thrift. One hundred and sixty-one Better farming societies supplied and produced improved seed in an increased quantity.

Mortgage Banks. The working of these banks had been far from satisfactory and the working capital went down from Rs. 20·59 lakhs in 1932-33 to Rs. 19·73 lakhs in 1933-34 and Rs. 18·86 lakhs in 1934-35. As would perhaps be expected at a time of falling prices, the mortgage banks were not in a position to repay the loans to the provincial bank, though overdue arrears slightly decreased from five to 4·7 lakhs.

The Government review on the report of the Registrar of Co-operative Societies in the Punjab notes in respect of the report for 1934 that " the outstanding and most encouraging feature lies in the fact that the co-operative movement in the Punjab shows unmistakable signs of successfully emerging from the economic depression of the last few years " and further adds that " another happy feature...........is the revival of the co-operative spirit ".

Madras. The process of liquidation was continued and the number of agricultural societies declined from 12,064 in 1932-33 to 11,647 in 1934-35, while the membership fell from 628,805 to 584,200. It was, however, gratifying to note that the amount of loans increased from a little over 92 lakhs to 124·7 lakhs during the period under review. It would appear that the bulk of the liquidation was confined to the CREDIT SOCIETIES, the number of which was 11,143 in 1934-35 as against 11,559 in 1932-33. The number of PURCHASE AND SALE SOCIETIES remained stationary. The value of the purchases and sales by these societies showed a substantial amount of expansion. As regards MILK SOCIETIES, of which there were thirteen at the end of 1933-34, only eleven survived at the end of 1934-35 with a membership of 430 and a share capital of Rs. 2,240. Milk valued at Rs. 1,04,237 was supplied by these societies to the Madras Milk Union. Besides these, there were twelve *kudimaramat* and Irrigation societies and eleven land reclamation societies. The latter had a paid-up capital of Rs. 18,250 and were responsible for reclaiming 1,725 acres of land. BETTER LIVING SOCIETIES are now being taken in hand by the Department with a view to extending the sphere of co-operative activities in the villages.

The Registrar of Co-operative Societies, Madras, writes in his report for 1933-34 as follows :—

" The report perhaps records more disappointments and difficulties of the movement than its achievements and the task of a Registrar of Co-operative Societies who has to write a report in the present times is rather gloomy. Co-operative societies are economic undertakings and they are as much affected by the universal economic depression as other departments of economic life. It has revealed the drawbacks and difficulties of the co-operative movement as perhaps nothing else can do."

For 1934-35 he remarks that " although the agricultural credit movement has not shown much progress during the last few years, at least further deterioration has been arrested ".

BOMBAY. Policy of rectification and consolidation pursued by the Department resulted in further liquidation of weak societies and weeding out undesirable membership. The number of AGRICULTURAL CREDIT SOCIETIES thus fell from 4,573 in 1932-33 to 4,502 in 1933-34 and 4,465 in 1934-35. The total membership figures declined from 248,504 to 236,869 and 227,458 and the working capital from about Rs. 402 thousand to Rs. 387 thousand and Rs. 375 thousand respectively during the same years. The increase in the reserve fund and the share capital from Rs. 6,769 and 2,943 thousand respectively in 1932-33 to Rs. 7,603 and 3,330 thousand in 1934-35 were, however, welcome features indicating the continued progress of these societies. Registration was granted very sparingly after elaborate enquiry and only when the circumstances indicated that the members were capable of managing their own affairs. Under these circumstances there is now a very keen demand for registration of credit societies in rural areas. The co-operation movement is also helping the agriculturist to adjust themselves to the changed conditions owing to economic depression, by giving loans on easier instalments for productive purposes, such as purchase of bullocks and costly implements. The special recovery officers sanctioned by the Government have been continued. They recovered Rs. 26,37,327 in 1934-35 and thus continued to disperse an erroneous impression held by members that the societies will not be able to recover money from them.

The situation of the CANAL SOCIETIES continued to be one of anxiety. During 1934-35, three of these societies were sent under liquidation leaving seventy-three at the end of year.

AGRICULTURAL NON-CREDIT SOCIETIES. The availability of efficient staff was a handicap in the further development of these societies. The COTTON SALE SOCIETIES still continue to be the most important in this group. These sold cotton worth Rs. thirty lakhs in 1933-34 and Rs. fifty-two lakhs in 1934-35 as against Rs. 26½ lakhs in 1932-33. This shows that in spite of low yield due to vagaries of nature, the Cotton Sale Societies went ahead and made considerable progress during the years under review. The two outstanding societies under this group are the Gadag Sale Society and Hubli Sale Society, which earned Rs. 24,000 and Rs. 16,000 respectively as commission for the year 1934-35. The sale Societies for other products such as *gul*, tobacco, chilly, mango, rice, etc., did not progress satisfactorily for one reason or the other.

The number of PURCHASE AND SALE UNIONS remained unchanged. The Nira Canal Purchase and Sale Society earned a commission of Rs. 5,633 and a profit of Rs. 4,709. Of the fourteen CROP PROTECTION SOCIETIES, thirteen are situated in Khandesh Division. The total area included in the area of operation was 48,898 acres in 1934-35 and the protection was secured at total cost of Rs. 17,388. It is gratifying to note that out of a total of 3,927 members, 260 are absentee owners. The FENCING SOCIETIES which increased from fourteen in 1932-33 to sixteen in 1934-35 became very popular particularly in Dharwar District. The total length of the fence and stone wall put up by the societies in Dharwar alone was 59,293 yards and protected an area of 20,403 acres in 1934-35. The seventeen CATTLE BREEDING SOCIETIES did good work during the years under review. These are becoming very popular.

Taluka Development Associations which were primarily intended for popularising the use of improved seeds, manure and implements, are increasing in popularity. During the years under review, two new associations came into existence bringing the total to eighty-four.

The Registrar of Co-operative Societies, Bombay is optimistic about the movement in his province and says in his report for 1934 that " the Co-operative Movement has shown great vitality during this critical period and I cannot help feeling that by strengthening the Co-operative Movement, and by extending its benefits substantial assistance could be given to agriculturists ".

In his report for 1935 he remarks that " the provision of cheap credit is not likely to achieve our goal, unless it is accompanied by a comprehensive programme for increasing the productivity of agriculture, and for cheapening its cost ". He adds that " while the urban movement continues to expand steadily on sound lines, the rural credit movement has also been growing in strength and liquidity ".

UNITED PROVINCES. The number of AGRICULTURAL CREDIT SOCIETIES increased from 5,082 in 1932-33 to 5,470 in 1934-35; membership from 1·06 to 1·08 lakhs and the owned capital from Rs. 55·4 lakhs to Rs. 58·5 lakhs. Working capital, however, decreased from Rs. 100·7 lakhs to Rs. 98·7 lakhs, while advances to members increased by ·11 lakh in 1933-34 and 3·71 lakhs in 1934-35 over the figures for 1932-33. The overdues including postponements amounted to Rs. 45·50 lakhs or sixty-three per cent. of the outstanding in 1934-35 as against 67·6 per cent. in 1933-34 and seventy-one per cent. in 1932-33.

NON-CREDIT SOCIETIES. Noticeable progress was made as regards the organisation of CANE SUPPLY SOCIETIES under official auspices. The number of such societies went up from twenty-six in 1932-33 to 111 in 1933-34. The bulk of these societies were in the districts of Dehra Dun, Meerut, Muzaffarnagar, Sitapur and Gorakhpur. There are considerable difficulties in the way of these societies, for they are not looked upon with particular favour by most of the sugar factories working in the province which prefer the purchase of cane through their own agencies. Despite all these difficulties, these societies worked at a substantial amount of profit. For instance, the societies in Dehra Dun earned by way of commission from the sale of cane a sum of Rs. 3,419 in 1934-35.

Thirty-five primary GHEE SALE SOCIETIES increased in membership from 661 to 977 and sold ghee worth Rs. 44,046 in 1934-35. Out of the two COTTON SALE SOCIETIES, the Iglas Society of Aligarh came to a standstill, while the other at Bilgram nearly doubled its membership in 1934-35 and made a profit of nearly Rs. 5,154 in 1933-34 and Rs. 12,000 in 1934-35.

The following remarks from the Report of the Registrar of Co-operative Societies, United Provinces, for 1933-34 may be found interesting :—

"Co-operative education is still defective and the finances of many societies are undoubtedly in a bad way. But in judging the results, one must not overlook the effect both on morale and finances of a series of indifferent and bad harvests and of the slump in agricultural prices. The development of co-operative loyalty is bound to be a slow process ; after all our raw material is the ignorant villager usually living on the margin of subsistence. Even so, there has been some progress in repayments. Financially, more than half the societies are sound."

DELHI. The number of societies went down from 216 in 1932-33 to 204 in 1934-35, though the membership figures showed an increase from 4,636 to 4,735 during the same period. No less than eleven societies had to be liquidated with a view to amalgamation and one had to be cancelled on account of its financial plight. The year was one of depression for the movement.

The societies advanced Rs. 39,072 during the year 1934-35 as against Rs. 27,991 in 1933-34. Repayments by the members in 1934-35 was Rs. 132·25 thousand as against Rs. 140·5 and Rs. 88·33 thousand in 1933-34 and 1932-33 respectively. The percentage of recovery to the total amount of loan was 7·6 per cent. in the last year under review as against 6·9 per cent. and 4·3 per cent. during the previous two years. Recoveries are still low which is not surprising considering the exceptional agricultural conditions through which the country has been passing.

Ten CONSOLIDATION OF HOLDING SOCIETIES, with 721 members, consolidated 1,115 acres in 1934-35, thereby reducing the number of blocks from 1,956 to 324. The departmental expenditure for consolidating an acre increased from fifteen annas in 1933-34 to Rs. two in 1934-35.

NORTH-WEST FRONTIER PROVINCE. The number of AGRICULTURAL CREDIT SOCIETIES further increased from 353 in 1932-33 to 470 in 1934-35. The membership similarly increased from 8,280 to 11,241 and the working capital from about Rs. six lakhs to Rs. 8·75 lakhs. The department was fully alive to the danger which attends indiscriminate increase in the number of societies and thus registered new societies only after satisfying themselves that the members understand the duties and the obligations attached to co-operative societies. Twenty-three classes for teaching the secretaries of the societies were held in 1934-35. These proved to be very useful.

The loans advanced by the Credit Societies in 1934-35 amounted to Rs. 2·16 lakhs as compared to Rs. 1·78 lakhs in 1932-33 and 1933-34. Indebtedness per member was Rs. seventy-two in 1933-34 as against sixty-nine in 1932-33.

The sixteen SOCIETIES FOR THE CONSOLIDATION OF LAND repartitioned 6,732 acres in 1934-35 as compared to 3,216 acres in 1933-34 and 2,510 acres in 1932-33. The cost per acre of consolidation was Rs. 1-5 in the Northern Circle and Rs. 3-1 in the Southern Circle. A holding in one of the villages in Bannu tehsil was reduced from eighty-four blocks to four blocks and the average size of the block increased from three *kanals* six *marlas* to sixty-nine *kanals*. Of the four SALES SOCIETIES organized in 1934-35, one handled 427·5 mds. of grapes and realised Rs. 3,271.

ASSAM. The total number of AGRICULTURAL SOCIETIES fell from 1,292 to 1,275 and the membership from 52,204 to 48,982 during the two years under review. The working capital, however, showed a slight increase from Rs. 32·5 lakhs to Rs. 33·5 lakhs during the same period. The societies issued loans to the members to the extent of Rs. 47,221 in 1934-35 and Rs. 55,251 in 1933-34 and recovered Rs. 1,11,040 and Rs. 1,09,730 respectively. Attempts to introduce weaving and sericulture as a subsidiary occupation among members of the co-operative societies under departmental agencies met with little progress and the condition of the movement as a whole was anything but encouraging.

BIHAR AND ORISSA. The movement was practically at a standstill during the period under report. The number of AGRICULTURAL SOCIETIES of all classes decreased by 25, while the share and working capital fell from Rs. 16·5 and Rs. 223·05 lakhs to Rs. 15·54 and Rs. 209·31 lakhs respectively. The membership showed, however, a small increase of 2,496 between 1933 and 1934 and stood at 2,30,734 at the end of 1934. Advances to members also declined from 6·98 lakhs in 1932 to 5·43 in 1934.

Sixty-nine GRAIN GOLAS with a membership of 24,633, an organisation characteristic of Bihar, made advances of cash and grain to the members to the extent of Rs. 96,179. Out of the total advances of Rs. 2·64 lakhs, no less than 1·34 lakhs were overdue. Two BETTER FARMING SOCIETIES were organised at Jahanabad and Aurangabad, while the Mayaganj Goala Society was reported to have done useful work in the matter of milk supply. The two IRRIGATION SOCIETIES in the Fatwa area had a bad year; one disappeared altogether and the other was about to follow suit.

The Registrar of Co-operative Societies, Bihar and Orissa, writes as follows in his report for 1933 :—

" The old idea that co-operation is synonymous with cheap borrowing has done a great harm and the sooner it disappears the better it will be for all concerned. Cheap and facile credit can do no good—it may even do serious harm—unless it is preceded by an adequate realization of the proper uses to which credit should be put, and this cannot be obtained without a thorough inculcation of the true principles of co-operation, *viz.*, self-help, mutual help and thrift, through the medium of rural reconstruction centres of the kind described above."

CENTRAL PROVINCES AND BERAR. There was a general set back during the period under review and the number of AGRICULTURAL SOCIETIES declined from 3,689 in 1932-33 to 3,589 in 1933-34, of which 3,010 were in the Central Provinces and 579 in Berar. The working capital declined from 158·5 lakhs to 152·25 lakhs, while membership declined from 52,630 to 50,044. The proportion of arrears to outstandings from the members of the societies has gone up further and is no less than seventy-seven per cent. in the Central Provinces and eighty-four per cent. in Berar. The movement was therefore anything but in a healthy state.

Besides the credit societies mentioned above, there were fifty-eight NON-CREDIT AGRICULTURAL SOCIETIES; thirty-five agricultural associations, twelve seed unions and nine *adat* or commission shops. The two landholders' societies had a working capital of Rs. 1,81,641 and a reserve fund of Rs. 8,587 and showed a profit of Rs. 3,018.

In his report for 1934 the Registrar of Co-operative Societies, Central Provinces and Berar remarks that " although the financial position of the movement as a whole is yet sound, it has ceased to be a live agency for rural credit except in Chhattisgarh. .... The main problem confronting the co-operative movement is the problem of heavy overdues ".

BENGAL. The conditions in Bengal were in no way different from those prevailing elsewhere in the country. The relevant figures are given below. The number of AGRICULTURAL SOCIETIES fell from 20,009 in 1932-33 to 19,892 in 1933-34. The membership figures also declined from 4,65,237 to 4,57,083 during the same period. The working capital, however, increased slightly from Rs. 569 crores to Rs. 573 crores. The issue of loans by these societies amounted to Rs. 32·74 lakhs as against Rs. 35·83 lakhs in 1932-33. There was a slight decrease in the repayments by members which amounted to Rs. 36·36 lakhs as against Rs. 36·55 lakhs in the preceding year, while the position of overdues improved a little, being Rs. 340 lakhs or 79·9 per cent. as against Rs. 346·59 lakhs or 80·9 per cent.

The Government sanctioned the establishment of five LAND MORTGAGE BANKS with a view to provide long term credit to the cultivator, advances being repayable within twenty years. The capital for these banks was to be raised by the issue of debentures by the Bengal Provincial Co-operative Bank Ltd., the interest being guaranteed by the Government. Only two out of the five proposed banks, however, materialised by the end of 1934.

The number of PURCHASE AND SALE SOCIETIES fell from eighty-five to seventy-five, their membership from 11,468 to 9,365 and the working capital from Rs. 6,61,249 to Rs. 5,59,304 during the year under review. The Central Paddy Sale Society handled about 98,537 maunds of paddy and rice as against 1,12,732 maunds in 1932-33. Nine hundred and thirty-seven IRRIGATION AND DRAINAGE SOCIETIES with a membership of 22,907, irrigated 1,56,781 *bigas* of land. Of the thirty-eight AGRICULTURAL ASSOCIATIONS in 1932-33 there remained thirty-seven in 1933-34. Of these the Naogaon Agricultural Association started a sugar factory and encouraged the cultivation of cane in Ganja Mahal area with a view to supplement the income of the members which deteriorated on account of the decline in the sale of *ganja*. A slight fall n the number of MILK SOCIETIES brought its total to 264 in 1933-34. The primary milk societies affiliated to the Calcutta Milk Union supplied milk valued at Rs. 1,49,928 as against 1,69,168 in the last year. The profit earned by them also suffered a corresponding reduction from Rs. 8,442 to Rs. 5,785, mainly due to the fall in the price of milk.

The Registrar of Co-operative Societies, Bengal, remarks in his report for 1934 that " the year continued to be equally bad, if not worse, for the co-operative movement, as the previous year ". In his report for 1935 he summarises the situation as follows :—

" With the close of the year, the co-operative movement has completed the sixth year of continuous stress and struggle through adverse economic conditions and the various internal difficulties of improvement. The year continued to be gloomy though the movement was able to maintain its ground without any serious set back."

HYDERABAD. Twenty-two rural credit societies were liquidated during the period under review and the total of such societies at the end of 1933-34 was 2,272 as against 2,130 during the previous year. The working capital remained about the same, while membership increased by 1,434, the total number of members being 45,065 as against 43,631 during the preceding year. Advances to members amounted to Rs. 2,45,829 as against Rs. 2,47,628 in the last year. The loans outstanding with members amounted to Rs. 61,70,824 principal and Rs. 29,74,037 interest. The Department continued its policy of gradual and cautious expansion and the greatest care was exercised in the selection of villages and individuals for enlistment.

MYSORE. The process of weeding out was in progress during the year and the number of AGRICULTURAL SOCIETIES decreased from 1,723 to 1,629, though the membership rose from 71,134 in 1932-33 to 71,951 in 1933-34.

Of these 1,629 societies, 1,534 were CREDIT INSTITUTIONS, twenty-seven were AGRICULTURAL SUPPLY SOCIETIES, forty-nine were GRAIN BANKS and the rest SALE SOCIETIES started for the co-operative sale of areca, cotton, cardamoms, etc. The credit societies had a membership of 68,946 and a working capital of Rs. 53,33,256. The loans issued and recovered by them amounted to Rs. 9,80,267 and Rs. 9,83,059 as against Rs. 10,55,997 and Rs. 10,26,553 respectively in the previous year. The net profit fell from Rs. 89,565 in 1932-33 to Rs. 56,300 in 1933-34. The twenty-seven supply societies had a membership of 767 with a working capital of Rs. 65,276. They sold goods to the value of Rs. 2,037 only. The forty-nine grain banks had a membership of 1,739 with the total working capital of Rs. 9,927 worth of grain. They are reported to have made a net profit of Rs. 2,517 during the year.

The Mysore Government in reviewing the progress of the Co-operative Movement remarks as follows :—" It is gratifying to note that there has been a steady growth in the movement from year to year. The number of societies in the year 1905-06 was only five with a membership of 362 and a working capital of Rs. 14,243. This number has at the end of the year under review increased to 2,088 societies having on the rolls 146,557 members with a working capital approximating Rs. 218 lakhs. Out of these, 1,825 or 87·4 per cent. are credit societies and the remaining 263 are non-credit societies ".

TRAVANCORE did not escape the effects of agricultural depression. The number of societies dropped from 1,412 to 1,373 in 1934-35, while the working capital also decreased from Rs. 36·33 lakhs to 35·66 lakhs. Membership also declined from 162,256 to 158,251. Arrears, however, showed a welcome decline from the level of 1932-33 and amounted to 61·7 per cent. as against 64·9 in 1932-33. The profits earned by these societies were as follows :—

Rs. 2,81,107 in 1932-33 as against Rs. 45,457 in 1933-34 and Rs. 85,291 in 1934-35.

The following remarks from the administration report for 1933-34 will be found interesting :—

" It has to be admitted that the condition of working of these institutions in general is very poor. Almost all of them are credit societies. The real aims and objects of the co-operative movement have not been understood by most of the members of the societies."

CHAPTER IX.

PUBLICATIONS OF THE AGRICULTURAL DEPARTMENTS.

Imperial. The Imperial Council of Agricultural Research continued the publication of the two bi-monthly Journals, 'Agriculture and Livestock in India', 'the Indian Journal of Agricultural Science' and one quarterly 'the Indian Journal of Veterinary Science and Animal Husbandry'. The total number of original articles published in 'Agriculture and Livestock in India' was ninety-seven, of which sixty-eight related to soils and crops and twenty-nine to animal husbandry matters. Of the one-hundred and nineteen original articles published in the 'Indian Journal of Agricultural Science', fifty-one may be classed as botanical, eighteen as chemical, twelve as entomological, twenty-nine as mycological, two bacteriological and seven as statistical. In the 'Indian Journal of Veterinary Science and Animal Husbandry' forty-seven original contributions were published, of which thirty-four dealt with diseases of livestock, five with animal breeding and nutrition, four with dairying and four with miscellaneous subjects.

In addition to the above-mentioned Journals, the Research Council also publishes Scientific Monographs and Miscellaneous Bulletins from time to time dealing with various subjects, and the following publications appeared during the period under review :

Scientific Monographs of the Imperial Council of Agricultural Research.

No. 4. Life-histories of Indian Microlepidoptera, Second Series : Cosmopterygidæ to Neopseustidæ. By T. Bainbrigge Fletcher, R.N., F.L.S., F.E.S.

No. 5. The Bombay Grasses. By the Revd. E. J. Blatter, S. J., Ph.D., F.L.S., and Mr. C. McCann, F.L.S.

No. 6. Helminth Parasites of the Domesticated Animals in India. By Mr. G. D. Bhalerao, M.Sc.

No. 7. The Influence of Manures on the Wilt Disease of *Cajanus indicus* Spreng, and the Isolation of Types resistant to the Disease. By W. McRae, M.A., D.Sc. (Edin.), F.L.S. and F. J. F. Shaw, D.Sc. (Lond.), A.R.C.S., F.L.S.

No. 8. The Silk Industry of Japan with notes on observations in the United States, England, France and Italy. By C. C. Ghosh, B.A., F.C.S.

No. 9. Mechanical Cultivation in India :- a history of large-scale experiments carried out by the Burmah-Shell Oil Storage and Distributing Company of India, Ltd. By C. P. G. Wade.

Miscellaneous Bulletins of the Imperial Council of Agricultural Research.

No. 1. List of Publications on Indian Entomology, 1930. By the Imperial Entomologist, Pusa.

No. 2. List of Publications on Indian Entomology, 1931. By the Imperial Entomologist, Pusa.

No. 3. List of Publications on Indian Entomology, 1932. By the Imperial Entomologist, and the Offg. Imperial Entomologist, Pusa.

No. 4. Host Plant Index of Indo-Ceylonese Coccidæ, By S. Ramachandran, L.Ag., and T. V. Ramakrishna Ayyar, B.A., Ph.D., F.Z.S.

No. 5. List of Publications on Indian Entomology, 1933. Compiled by the Offg. Imperial Entomologist, Pusa.

No. 7. List of Publications on Indian Entomology, 1934. Compiled by the Offg. Imperial Entomologist, and the Imperial Entomologist, Pusa.

A second edition of Scientific Monograph No. 3 ‘ The Open Pan System of White Sugar Manufacture ’ (1932) by R. C. Srivastava and a second edition of Pusa Bulletin No. 187 ‘ The Production of Cigarette Tobacco by Flue Curing ’ (1928), by Dr. F. J. F. Shaw and Mr. Kashi Ram were published to meet the public demand. A book entitled 'A Description of the Imperial Institute of Veterinary Research, Muktesar, and its Substation, the Imperial Veterinary Serum Institute, Izatnagar,' by Mr. F. Ware was also published. One Monograph, six Miscellaneous Bulletins and one book entitled 'A Handbook of Statistics for use in Plant Breeding and Agricultural Problems' by Dr. F. J. F. Shaw were in the press at the close of the period under review.

Provincial and State publications. The MADRAS Department of Agriculture published in English and in the vernaculars thirty-two 'Leaflets', three 'Notes' and seven 'Bulletins'. The annual Villagers' Calendar continued to be printed in English and in the four principal vernaculars of the Presidency, the size of edition running to about 58,000 each year. The third revised edition of the Manual of Elementary Botany for India by Diwan Bahadur K. Rangachariar was published during the period under review. The 'Madras Agricultural Journal', a monthly magazine of the Madras Agricultural Students' Union, continued to be published with the help and co-operation of the departmental staff.

In BOMBAY, nine bulletins were issued during the period under review. The magazine, which is issued quarterly by the Poona Agricultural College, continued to be popular and it served a useful purpose in keeping the past students of the College in touch with the activities of the Institution and the Department.

In BENGAL leaflets and bulletins were published on *gur*-making, cattle-breeding, destruction of water-hyacinth, insect pests and fungal diseases of crops.

The UNITED PROVINCES Department of Agriculture issued seventeen pamphlets, and twenty-seven bulletins, of which sixteen were in the Fruit Series. The departmental magazines, *viz.*, *Kisan Upkarak* and *Mufid-ul-Mazarain*, were made more attractive and useful. The circulation of these steadily increased from 888 in 1933 to 2,762 in 1934-35. The Manual and Financial Handbook of the Department were in preparation, the former being entirely new and the latter a revised edition of the original Financial Handbook.

The PUNJAB Agricultural Department continued to publish 'Seasonal Notes' and issued twenty-four leaflets and one bulletin during the period under review. Mention should also be made of the fourteen research publications issued by the Punjab Irrigation Research Institute.

In BURMA the Department of Agriculture issued three leaflets, three surveys and two bulletins during the period under review.

The BIHAR AND ORISSA Department of Agriculture issued sixteen bulletins and leaflets on various phases of agricultural improvements. In addition to these, the earthquake of 1934 necessitated the issue of several pamphlets on *gur*-making, *khandsari* sugar-making, methods of dealing with sand deposits and the use of green and artificial manures. The Journal *Kisan* has aroused considerable interest amongst literate rural public.

The CENTRAL PROVINCES Department of Agriculture issued four bulletins and twelve popular leaflets; the latter were also published in vernaculars (Hindi and Marathi). The Agricultural College continued to issue the College Magazine.

In ASSAM twenty bulletins and papers were issued. In addition general leaflets on better methods of cultivation of paying crops and on improved agricultural methods were issued.

The NORTH-WEST FRONTIER PROVINCE Department of Agriculture issued five bulletins, of which bulletins dealing with the rotation of crops and the use of tops of sugarcane as seed were of particular interest.

The HYDERABAD Department of Agriculture continued to publish vernacular leaflets on improved varieties of crops, improved methods of cultivation, improved manures, etc. A Poultry Survey Report was published during 1933-34. The Hyderabad Farming Association continued to publish its magazine 'Hyderabad Farmer' to which articles were contributed by the Officers of the Department.

The Department of Agriculture in TRAVANCORE published six leaflets and six short notes, copies of which were distributed free to the ryots. A book entitled 'Diseases of the Coconut Palm' was issued by the Mycologist.

The COCHIN Department of Agriculture issued eleven leaflets which were distributed free to the ryots.

The BARODA Department of Agriculture issued the Annual Agricultural Calendar as usual.

A complete list of agricultural publications issued in India during the period is given in Appendix X.

CHAPTER X.

RECEIPTS AND EXPENDITURE OF THE AGRICULTURAL AND VETERINARY DEPARTMENTS.

The financial aspects of the Agricultural and Veterinary Departments of the Imperial and the Provincial Governments during the three years 1932-33 to 1934-35, are summarised in the Statements I and II appended to this chapter. It may be mentioned that the expenditure of the Agricultural Departments in the Provinces and States includes the expenditure on animal husbandry also, except in the Punjab where it is borne by the Civil Veterinary Department. Statement III shows the expenditure on animal husbandry in the various Provinces and States during 1933-34 and 1934-35.

Financial stringency was responsible to a great extent in circumscribing the activities of the various Agricultural and Veterinary Departments in the provinces. In Burma, for instance, the teaching side at the Agricultural College at Mandalay had to be closed down; the establishment of the Dacca Agricultural Institute was again postponed; the post of the Livestock Officer in the Punjab continued to be held in abeyance. Valuable research work was, however, carried out and in some cases initiated as a result of the grants made by the Imperial Council of Agricultural Research and the Indian Central Cotton Committee, and the assistance of these two bodies has been generously acknowledged in the various departmental reports of the provinces.

STATEMENT I.

Receipts and Expenditure of the Agricultural Departments in India for 1933-34 and 1934-35.

—	1932-33		1933-34		1934-35	
	Receipts.	Expenditure.	Receipts.	Expenditure.	Receipts.	Expenditure.
	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.
Imperial Department of Agriculture.	2,84,416	9,09,599	2,24,515	8,89,676	2,02,106	9,68,471
Madras*	2,02,372	16,93,214	1,86,065	17,45,928	1,82,436	18,44,341
Bombay Presidency (Proper).	2,15,975	11,22,464	1,81,016	10,83,430	2,10,731	10,86,257
Sind	11,018	4,04,975	52,364	3,96,140	53,044	5,13,351†
Bengal	91,235	9,09,970	77,271	11,11,848	86,672	9,35,000
United Provinces	3,47,713	18,67,591	3,26,995	19,43,770	3,63,990	19,89,495
Punjab	4,56,206	18,17,637	5,47,689	21,50,006	5,93,168	22,16,122
Burma	1,05,233	7,75,829	(*a*)1,00,758	(*b*) 8,55,858	(*c*) 1,46,866	(*b*) 8,15,236
Bihar and Orissa	1,02,438	5,36,558	1,10,494	5,55,819	1,13,054	5,67,398
Central Provinces	2,88,312	8,94,175	2,30,909	(*d*) 9,47,938	2,35,174	(*e*) 9,83,185
Assam	65,745	4,00,549	56,559	3,91,563	58,479	3,97,786
North-West Frontier Province.	30,824	72,417	38,708	1,02,605	51,947	1,00,000
Baluchistan	3,266	16,231	3,274	33,208	3,701	41,452
TOTAL	22,04,753	1,14,21,239	21,37,517	1,22,07,789	23,01,368	1,24,58,004
Indian States.						
Hyderabad	..	..	34,305	9,32,400	35,000	9,18,000
Mysore	..	..	1,69,253	5,69,824	1,55,967	5,46,960
Baroda	..	..	37,266	2,12,599	39,557	2,00,625
Travancore	..	..	14,717	1,37,378	17,530	1,43,420
Cochin	..	..	15,804	86,081	17,337	90,030
Bhopal	..	..	(*f*) 1,752	(*f*) 38,732	(*f*) 2,347	(*f*) 32,613
TOTAL	..	..	2,73,097	19,77,014	2,67,738	19,31,707

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* The figures do not include the schemes financed by the Imperial Council of Agricultural Research and the Indian Central Cotton Committee and expenditure on stores purchased in England.

† Includes the expenditure incurred on engineering and agricultural propaganda schemes financed by Central Government.

(*a*) Includes Rs. 8,014 contributed by the Indian Central Cotton Committee.

(*b*) Does not include "Charges in England" but includes expenditure on account of "Botanical and other Public Gardens", which is not the expenditure of the Agricultural Department proper.

(*c*) Includes Rs. 10,080 contributed by the Indian Central Cotton Committee and Rs. 50,000 by the Imperial Council of Agricultural Research.

(*d*) This includes the grant of Rs. 81,196 contributed by the Indian Central Cotton Committee and the Imperial Council of Agricultural Research.

(*e*) This includes the grant of Rs. 1,05,622 contributed by the Indian Central Cotton Committee and the Imperial Council of Agricultural Research.

(*f*) Including the Departments of Agriculture and State Laboratory, Meteorological Department and Taxidermy Section.

STATEMENT II.

Receipts and Expenditure of the Veterinary Departments in India for 1933-34 and 1934-35.

—	1932-33		1933-34		1934-35	
	Receipts.	Expenditure.	Receipts.	Expenditure.	Receipts.	Expenditure.
	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.
Madras . . .	45,292	8,99,394	45,931	9,04,392	47,079	9,81,737
Bombay Presidency (Proper).	17,005	4,90,407	14,342	4,69,486	17,869	4,74,893
Sind	..	1,18,534	..	1,05,481	..	1,06,463
Bengal	84,869	2,17,669	1,43,615	4,83,602	1,28,437	4,69,118
United Provinces . .	1,37,866	4,58,047	1,26,381	4,14,918	1,26,226	4,12,101
Punjab	1,49,225	18,27,591	1,48,246	18,93,252	1,27,897	19,80,505
Burma	20,679	5,56,351	21,738	4,79,744	23,009	4,40,941
Bihar and Orissa . .	1,24,043	3,90,576	1,12,801	6,73,871	1,21,049	6,68,694
Central Provinces . .	1,695	3,80,419	..	3,74,832	..	3,93,940
Assam	1,114	1,73,737	1,548	1,69,281	1,188	1,79,442
North-West Frontier Province.	..	89,156	..	1,15,128	..	1,15,981
Imperial Institute of Veterinary Research, Muktesar and its sub-station, Izatnagar.	9,22,805	6,34,456	5,96,602	6,38,565	5,78,725	6,41,699
TOTAL .	15,09,011	62,36,337	12,11,204	67,22,552	11,71,479	68,15,514
Baluchistan . . .	..	61,962	..	63,356	..	65,416
Coorg	300	19,540	96	19,095	64	17,617
Ajmere-Merwara . .	..	8,305	..	..	..	..
TOTAL .	300	89,807	96	82,451	64	83,033
Indian States.						
Hyderabad . . .	14,086	4,86,163	6,239	4,81,140	..	..
Travancore . . .	..	..	342	31,982	359	32,159
Baroda	..	..	37,266	2,12,599	39,557	2,00,625
Cochin	..	..	..	23,856	..	28,528
TOTAL .	14,086	4,86,163	43,847	7,49,577	39,916	2,61,312

STATEMENT III.

Showing Expenditure incurred on Animal Husbandry in Provinces and States in India during 1933-34 and 1934-35.

Name of the Province or State	Expenditure during	
	1933-34	1934-35
	Rs.	Rs.
Madras	98,657	1,02,104
Bombay	1,45,710	1,35,867
Sind	9,580	10,825
Bengal	70,644	54,245
United Provinces	1,14,433	1,12,459
Punjab	10,24,813	10,50,526
Burma	3,983	3,831
Bihar and Orissa	44,119	42,938
Central Provinces	98,280	96,732
Assam	1,02,500	1,06,800
North-West Frontier Province	..	..
Baluchistan	..	..
Hyderabad	32,888	32,888
Mysore	3,08,408	2,89,481
Baroda	1,05,031	97,418
Travancore	20,272	15,930
Cochin	4,691	5,570
Bhopal	*Nil*	*Nil*
Director, Imperial Institute of Agricultural Research	3,23,400	3,51,700
TOTAL	25,07,409	25,09,314

APPENDICES.

APPENDIX I.

Areas under new and improved varieties of crops in India during 1933-34 and 1934-35.

Name of Province	Name of crop	Area in acres								
		1932-33			1933-34			1934-35		
		Departmental seed	Natural spread	Total	Departmental seed	Natural spread	Total	Departmental seed	Natural spread	Total
Madras	Paddy	37,968	526,411	564,379	152,365	641,212	793,577	202,335	726,506	928,841
	Cotton	75,684	275,706	351,390	54,623	310,850	365,473	63,596	425,910	489,506
	Sugarcane	6,547	18,253	24,800	7,471	34,624	42,095	12,480	45,463	57,943
	Miscellaneous	19,383	120,280	139,663	9,417	97,479	106,896	9,188	63,811	72,999
Bombay Presidency Proper.	Cotton—									
	1027 A. L. F.	239,436	..	239,436	234,834	10	234,844	231,431	50	231,481
	Wagad 8	..	..	..	460	340	800	222	375	597
	Jayawant	55,109	53,486	108,590	34,874	148,538	183,412	27,333	135,106	162,439
	Gadag No. 1	22,514	31,970	54,484	24,620	44,820	69,440	25,012	65,238	90,250
	Banilla	5,310	123,600	128,910	26,694	132,440	159,134	78,030	51,098	129,128
	N. R.	735	38,195	38,930	962	4,750	5,712	1,023	2,306	3,329
	TOTAL COTTON	323,104	247,251	570,350	322,444	330,898	653,342	363,051	254,173	617,224
	Groundnut	254	848,549	848,803	159	579,055	579,214	2,088	467,760	469,848
	Wheat—									
	(Pusa 4,808,224,168,162)	868	19,658	20,526	1,946	34,948	36,894	3,378	38,773	42,151
	Sugarcane	482	4,640	5,122	1,546	3,982	5,528	270	10,800	11,070
	Bajri Akola	872	5,235	6,107	1,629	33,994	35,623	4,346	33,601	37,947

	Paddy (Rice)	1,726	84,867	86,593	2,017	800	2,817	2,799	12,615	15,414
	Tobacco Nos. 6 and 28	566	2,548	3,114	501	2,224	2,725	803	2,730	3,533
	Nagli	260	975	1,235	311	1,789	2,100	146	1,710	1,856
	Jowar	..	..	..	450	768	1,218	588	800	1,388
	Potato (Italian)	..	..	..	..	..	..	100	400	500
	Fruits	450	2,706	3,156	244	3,202	3,446	309	3,852	4,161
Sind	Cotton—									
	American	3,088	95,560	98,648	2,880	97,733	100,613	11,410	113,734	125,144
	Deshi	5,427	104,600	110,027	3,040	6,250	9,290	19,606	58,022	77,628
	Egyptian	..	..	..	154	72	226	938	580	1,518
	TOTAL COTTON	8,515	200,160	208,675	6,074	104,055	110,129	31,954	172,336	204,290
	Wheat (Pusa 12, 114, A. T. 38, Punjab 8A, 11, C. P. H. 47, H. S. W. and N. W.).	3,073	170,864	173,937	4,639	30,926	35,565	6,217	99,000	105,217
	Rice— Kangri 27, Prong, Jajai, Bengalo, Hybrid, etc.	588	8,300	8,888	11,075	9,000	20,075	992	26,795	27,787
	Miscellaneous crops *Mung*, *jowar* and *Bajri*, Mustard and *Jambho*, Oilseeds, Groundnuts, Soya-Beans, etc.	135	565	700	999	3,450	4,449	2,251	12,271	14,522
Bengal	Paddy (*Indrasil*, *Dudsar*, *Jhingasail*, *Kataktara*, *Charnock* and *Surajamukhi*).	10,945	292,572	303,517	7,099	492,159	499,258	14,928	501,238	516,166
	Jute	4,630	953,081	957,711	5,113	1,102,331	1,107,444	2,265	1,134,337	1,136,602
	Sugarcane	3,529	94,643	98,172	609	112,695	113,304	1,876	168,886	170,762
	Other crops	321	3,815	4,136	426	8,545	8,971	1,675	11,643	13,318
United Provinces	Wheat	156,000	1,940,000	2,096,000	164,000	2,096,000	2,260,000	190,000	2,260,000	2,450,000
	Cotton	34,000	271,000	305,000	24,000	305,000	329,000	28,000	329,000	357,000
	Sugarcane	50,000	1,240,000	1,290,000	40,500	1,404,500	1,445,000	72,500	1,598,500	1,671,000

Areas under new and improved varieties of crops in India during 1933-34 and 1934-35—contd.

Name of Province	Name of crop	AREA IN ACRES								
		1932-33			1933-34			1934-35		
		Departmental seed	Natural spread	Total	Departmental seed	Natural spread	Total	Departmental seed	Natural spread	Total
United Provinces—*contd.*	Barley	6,000	39,000	45,000	11,500	45,000	56,500	25,000	56,500	81,500
	Gram	12,000	87,000	99,000	14,200	99,000	113,200	18,000	113,200	131,200
	Miscellaneous	70,000	143,000	213,000	30,000	213,000	243,000	24,000	243,000	267,000
Punjab	Cotton American 4 F	121,650	623,810	745,460	129,600	621,400	751,000	191,800	577,900	769,700
	Cotton American 289 F	4,300	26,500	30,800	4,000	27,000	31,000	2,400	53,600	56,000
	Improved *Desi* Cottons—									
	Indicum (Mollisoni)	62,780	426,720	489,500	143,200	585,200	728,400	145,000	582,200	727,200
	Neglectum	2,220	61,780	64,000	200	74,100	74,300	800	51,200	52,000
	Other improved *desi* varieties.	120	25,580	25,700	2,200	10,700	12,900	2,000	8,800	10,800
	TOTAL COTTON	191,070	1,164,390	1,355,460	279,206	1,318,400	1,597,600	342,000	1,273,700	1,615,700
	Wheat (8A)	43,600	2,350,600	2,394,200	160,500	2,559,300	2,719,800	132,200	2,909,800	3,042,000
	Punjab (11)	..	63,500	63,500	..	34,700	34,700	..	35,000	35,000
	Improved varieties	3,200	54,400	57,600	7,900	71,100	79,000	18,150	154,150	172,300
	TOTAL	46,800	2,468,500	2,515,300	168,400	2,665,100	2,833,500	150,350	3,098,950	3,249,300
	Improved sugarcane	2,030	172,740	174,770	1,000	186,300	187,300	2,350	198,250	200,600
	Paddy	68,246	600,502	668,748	221,586	638,524	860,110	311,348	721,167	1,032,515
	Groundnut	283	25,316	25,599	1,246	19,875	21,121	284	27,150	27,434

Burma	Cotton	2,076	750	2,826	5,626	1,750	7,376	3,899	1,800	5,699
	Gram	1,180	145,629	146,809	1,138	137,455	138,593	1,352	144,620	145,972
	Sugarcane	64	3,278	3,342	114	8,062	8,176	218	13,093	13,311
	Wheat	71	13,500	13,571	191	13,500	13,691	80	15,995	16,075
	Jowar	784	610	1,394	744	750	1,494	714	300	1,014
	Butter Beans	1,133	7,926	9,059	4,811	6,255	11,066	514	5,961	6,475
	Pessinngon	244	1,856	2,100	353	6,149	6,502	428	48,392	48,820
	Sesamum	3,253	4,777	8,030	4,779	6,529	11,308	6,720	12,295	19,015
Bihar and Orissa	Sugarcane	708	229,317	230,025	..	..	297,351	..	..	358,363
	Wheat (Pusa 12,52)	3,035	34,872	37,907	..	..	45,484	3,735	50,607	54,342
	Paddy—									
	Dahia	660	12,105	12,765	..	..	16,956	622	21,880	22,502
	(Kankesal, Kanke II, Latisal, Kujang No. I, Buromal, Badshahbhog, Benibhog, Kalagiri, Biradi, Bankoi, Khurda, Cuttack Nos. 1, 2, 3, 4, 5, etc.).	362	8,179	8,541	..	..	11,310	835	12,336	13,171
	TOTAL PADDY	1,022	20,284	21,306	..	..	28,266	1,457	34,216	35,673
	Jute	..	..	..	..	..	945	..	..	1,014
	Barley, Pusa 21	..	..	..	1,325	4,000	5,325	241	5,500	5,741
	Groundnut	147	2,262	2,409	99	2,104	2,303	227	2,260	2,487
	Tobacco, P. 28	10	839	849	10	961	971	5	150	155
	Gram (Sabour 4, Pusa 17)	202	2,024	2,226	..	..	2,977	486	3,728	4,214
	Miscellaneous (Pusa Linseed 12, Sabour Peas 5, 10, Potato, Onion, Garlic, *Juar*, Ginger, Gingelly, Lentil *Sonamung*, *Kheshari*, *Dhaincha*, *Potal*, *Rahar*, Sabour 7, G. O., Elephant grass, Maize, Vegetables).	1,732	10,877	12,609	455	5,889	6,350	697	7,908	8,346

Areas under new and improved varieties of crops in India during 1933-34 and 1934-35—contd.

Name of Province	Name of crop	AREA IN ACRES								
		1932-33			1933-34			1934-35		
		Depart-mental seed	Natural spread	Total	Depart-mental seed	Natural spread	Total	Depart-mental seed	Natural spread	Total
Central Provinces	Wheat	..	..	458,932	..	..	477,918	..	..	572,399
	Rice	..	..	400,281	..	..	468,157	..	..	528,556
	Cotton	..	..	396,765	..	..	429,853	..	..	441,498
	Juar	..	..	137,948	..	..	138,030	..	..	150,557
	Groundnut	..	..	128,242	..	..	139,980	..	..	111,568
	Other crops	..	..	80,043	..	..	39,874	..	..	38,659
Assam	Rice	4,943	31,898	36,841	2,187	32,155	34,342	2,329	28,488	30,817
	Sugarcane	23	8,828	8,851	17	10,010	10,027	23	7,813	7,836
	Potato	263	13,963	14,226	147	2,839	2,986	533	1,888	2,421
	Jute	621	44,469	45,090	33	31,665	31,698	37	645	682
N.-W. F. P.	Wheat	..	100	100	723	800	1,523	14,943	11,000	25,943
	Maize	..	400	400	95	2,500	2,595	4,360	3,000	7,360
	Sugarcane	..	..	..	201	..	201	45	..	45
	Cotton	..	..	..	..	..	..	200	100	300
Baluchistan	..	A seed farm of about 300 acres was opened in the Nasirabad in 1934-35. Experimental work is in progress. No improved varieties of seeds were issued so far.								
INDIAN STATES.										
	Sugarcane	45	..	45	165	6,402	6,567	131	14,228	14,359
	Groundnut	1,867	..	1,867	2,241	16,132	18,373	959	38,437	39,396

Hyderabad .	*Bajra*	217	..	217	128	1,084	1,212	404	1,360	1,824
	Wheat	50	..	50	76	295	371	307	515	822
	Paddy	86	..	86	99	488	587	643	2,689	3,332
	Jowar	6	..	6	926	..	926	63	..	63
	Sunn-hemp . . .	6	..	6	..	..	..	..	..	..
	Cotton	194,675	..	194,675	23,934	8,000	31,934	17,044	2,630	19,674
	Potatoes	3	..	3	..	..	..	..	..	..
	Maize	1	..	1	..	..	..	..	..	..
	Turmeric	1	..	1	..	..	..	..	..	..
Mysore .	*Ragi*	15,451	188,231	203,682	16,027	305,467	321,494	11,763	302,600	404,363
	Paddy	11,837	162,515	174,352	17,876	164,446	182,322	17,846	164,511	182,357
	Sugarcane . . .	1,001	6,903	7,904	2,418	8,165	10,583	12,134	8,364	20,498
	Groundnut . . .	1,049	33,357	34,406	1,017	44,694	45,711	844	44,000	44,844
	Cotton	192,045	32,109	51,354	18,747	29,646	48,393	23,432	8,623	32,055
	Miscellaneous . . .	1,301	121	1,422	103	182	285	19,093	352	19,445
Baroda . .	Cotton	13,156	16,807	29,963	5,113	3,380	8,493	28,125	..	28,125
	Wheat Pusa 4 . . .	93	6,062	6,149	400	124	524	100	14,284	14,384
	Rice	27	8,395	8,422	..	..	..	100	..	100
	Jowar	10	50	60	120	..	120	..	..	..
Travancore . .	Paddy	440	(Not available)	440	561	(Not available)	561	710	(Not available)	710
Cochin . .	Paddy	73	1,352	1,425	96	2,844	2,940	127	4,087	4,214
	Sugarcane . . .	1	1	2	1	4	5	1	12	13
	Cotton	..	2,128	2,128	..	2,960	2,960	..	5,737	5,737
	Pine apple . . .	..	40	40	..	45	45	..	50	50
	Cocoanut	10	..	10	12	..	12	16	..	16
Bhopal . .	Wheat	238	..	238	251	952	1,203	121	4,812	4,933
	Gram	..	..	..	..	..	..	28	..	28

Areas under new and improved varieties of crops in India during 1933-34 and 1934-35—concld.

Name of Province	Name of crop	AREA IN ACRES								
		1932-33			1933-34			1934-35		
		Departmental seed	Natural spread	Total	Departmental seed	Natural spread	Total	Departmental seed	Natural spread	Total
Bhopal	Linseed	..	..	..	..	..	..	12	..	12
	Til	..	..	..	..	..	..	51	..	51
	Sugarcane		..	..	..	..	..	7	..	7
	Groundnut	..	..	..	..	..	..	1	..	1
Gwalior	Cotton, *Jowar*, Wheat, Gram, Linseed, *Arhar* and Barley.	16,000	2,500	18,500	35,000	10,500	45,500	60,000	28,000	88,000
Kashmir	Rice	329	..	329	464	Not available	464	..	..	..
	Wheat	235	..	235	343	..	343	..	..	..
	Barley	22	..	22	6	..	6	..	..	..
	Maize	1,171	..	1,171	919	..	919	..	..	..
	Sugarcorn	201	..	201	103	..	103	..	..	..
	Oilseeds	10	..	10	54	..	54	..	..	..
	Potatoes	6	..	6	7	..	7	..	..	..
	Beans	8	..	8	16	..	16	..	..	..
	Peas	66	..	66	99	..	99	..	..	..
	Sugarcane	19 (*kanals*).	..	19 (*kanals*).	88 (*gandaras*).	..	88 (*gandaras*).	..	..	..
	Miscellaneous crops	329	..	329	139	..	139	..	..	..
	Vegetable seeds.	172	..	172	229	..	229	..	..	..

APPENDIX II.

List of Agricultural Stations in India in 1933-34 and 1934-35.

Province	Agricultural Stations	Area in acres	Officer in immediate charge	Supervising Officer	REMARKS
Imperial Department of Agriculture in India.	Pusa	732*	Assistant Agriculturist	Imperial Agriculturist	Imperial Institute of Agricultural Research.
	New Delhi	476*	Assistant Economic Botanist	Director, Imperial Institute of Agricultural Research.	(*cultivated area.)
	Karnal (Botanical Sub-Station)	143	Superintendent	Imperial Economic Botanist	Financed by Imperial Council of Agricultural Research.
	Karnal (Sugarcane Sub-Station)	30	Assistant	Sugarcane Expert	Ditto.
	Karnal (Cattle Breeding Farm)	1,981	Superintendent	Imperial Dairy Expert	
	Bangalore	160	Ditto	Ditto	Dairy Farm.
	Wellington	62	Supervisor	Ditto	Ditto.
	Coimbatore	90	Farm Manager	Sugarcane Expert.	
Madras	Berhampore	33	Superintendent	Paddy Specialist, Coimbatore.	
	Samalkota	57	Farm Manager	Deputy Director of Agriculture, I Circle, Vizagapatam.	
	Anakapalle	104	Superintendent	Director of Agriculture, Madras.	
	Maruteru	50	Ditto	Paddy Specialist, Coimbatore.	
	Guntur	150	Farm Manager	Deputy Director of Agriculture, II Circle, Guntur.	
	Hagari	225	Ditto	Deputy Director of Agriculture, III Circle, St. Thomas Mount.	
	Nandyal	88	Ditto		
	Anantarajupeta	49·56	Superintendent		
	Gudiyatham	34·64	Farm Manager	Superintendent, Agricultural Research Station, Anakapalle.	
	Kalahasti	9	Ditto	Deputy Director of Agriculture, IV Circle, St. Thomas Mount.	

List of Agricultural Stations in India in 1933-34 and 1934-35—contd.

Province	Agricultural Stations	Area in acres	Officer in immediate charge	Supervising Officer	REMARKS
Madras—*contd*	Erayanur, Tindivanam	49·28	Farm Manager	Oil Seeds Specialist, Coimbatore.	
	Palur	52	Ditto	Deputy Director of Agriculture, IV Circle, St. Thomas Mount.	
	Aduthurai	50	Superintendent	Deputy Director of Agriculture, V Circle, Trichinopoly.	
	Pattukottai	30	Farm Manager		
	Koilpatti	140	Superintendent	Deputy Director of Agriculture, VI Circle, Madura.	
	Pattambi	82	Ditto	Paddy Specialist, Coimbatore.	
	Taliparamba	86	Farm Manager	Deputy Director of Agriculture, VII Circle, Tellichery.	
	Kasaragod and Nileshwar	178	Ditto	Oil Seeds Specialist, Coimbatore.	
	Nanjanad	160	Superintendent	Deputy Director of Agriculture, VIII Circle, Coimbatore.	Pomological Stations.
	Coonoor, Burliar and Kallar	30	Farm Manager	Curator, Government Botanic Garden, Ootacamund.	
	Coimbatore	400	Superintendent	Principal, Agricultural College, Coimbatore.	
	Hosur	1,660	Ditto	Deputy Director of Agriculture, Livestock, Hosur.	
	Jalgaon	107*	Superintendent, Jalgaon Farm, Jalgaon, East Khandesh.	Deputy Director of Agriculture, North Central Division, Nasik.	*204 acres in 1933-34.
	Bhadgaon	209	Superintendent, Bhadgaon Farm, Bhadgaon, East Khandesh.		This is financed by Indian Central Cotton Committee, Bombay.
	Dhulia	28	Headmaster, Agricultural School, Dhulia, West Khandesh.		
	Karjat	15	Rice Specialist, Karjat		Rice Research Station.

Bombay	Kopargaon	44*	Superintendent, Kopargaon Farm.	Deputy Director of Agriculture, South Central Division, Poona.	Sugarcane experimental and confirmation station. *Out of the total area of 110 acres and 19 *gunthas*, 33 acres were under cultivation during 1933-34, 31 acres were leased out and the remaining area was left for grazing purpose. Only 44 acres and 30 *gunthas* were under cultivation during 1934-35.
	Ratnagiri	22	Superintendent, Ratnagiri Farm.		Rice and *Nagli* Breeding Station.
	Mohol	55	Superintendent, Mohol Farm		This Farm is maintained for testing and showing methods of dry cultivation and land development in famine area.
	Dharwar Farm	146	Superintendent, Dharwar Farm.	Deputy Director of Agriculture, Southern Division, Dharwar.	
	Gokak Canal Farm, *Arbhavi* (Belgaum)	62	Superintendent, Gokak Canal Farm.		
	Mugad	9	Rice Breeder		Rice breeding station.
	Kumpta Farm	68	Superintendent, Kumpta Farm.		
	Tegur	370	Agricultural Sub-Overseer, Tegur.		Cattle breeding farm.
	Surat	294	Superintendent, Agricultural Station, Surat and Cotton Breeder, South Gujarat, Surat.	Deputy Director of Agriculture, Gujarat, Surat.	Research and experiment in cotton, *jowar* breeding, cultural and manurial experiments on cotton and *jowar*; maintaining and multiplying pure seed for distribution.
	Nadiad	13	Tobacco Breeder, Nadiad		Tobacco and *Bajri* Research Station. Improvement of local varieties of tobacco and *bajri* by breeding the best strains and multiplying their pure seed for distribution. Also evolving new varieties suitable for cigarette making.
	Broach	22	Superintendent, Broach Farm, and Cotton Breeder, Broach.		Breeding cotton, *jowar*, and wheat types best suited to Broach tract. Breeding wilt-resistant type of cotton combined with other economic characters.

List of Agricultural Stations in India in 1933-34 and 1934-35—contd.

Province	Agricultural Stations	Area in acres	Officer in immediate charge	Supervising Officer	REMARKS
Bombay—*contd.*	Dohad	68	Superintendent, Dohad Farm	Deputy Director of Agriculture, Gujarat, Surat.	Improving staple crop of maize, wheat and groundnut and multiplying seeds for distribution. Demonstration of improved cultivation methods to *Bhil* cultivators.
	Viramgam	13	Cotton Breeder, North Gujarat, Viramgam.	Ditto	Cotton and *Jowar* Breeding Station. Improvement in local types of Wagad cotton and *jowar* by breeding.
	Agricultural College Farm, Poona	275	Superintendent	Professor of Agriculture, Agricultural College, Poona.	
	Agricultural College Dairy, Kirkee	362	Manager		
	Karjat (Kolaba)	6	Superintendent	Crop Botanist to Government, Bombay, Karjat, Kolaba Dt.	Rice Breeding Station.
	Niphad (Nasik)	14	Ditto		Cereal Breeding Station.
	Northcote Cattle Breeding Farm, Chharodi, Dt. Ahmedabad.	2,278	Manager	Livestock Expert to Government, Agricultural College, Poona.	Cattle Breeding Farm.
	Bankapur, Dt. Dharwar	96(1)* 152(2)	Ditto	Ditto	Cattle Breeding Farm. *1. Farm area. 2. Grazing area at Kalasgiri attached to the Farm.
	Ganeshkhind Fruit Experiment Station, Kirkee.	80	Superintendent	Horticulturist to Government, Agricultural College, Poona.	
	Modibag Agricultural College, Poona	12	Ditto	Ditto	
	Government Auxiliary Farm, Nasirabad	311	Manager		
	Government Auxiliary Farm, Shahdadkote.	180	Ditto		
	Government Auxiliary Farm, Lundo	457	Ditto		
	Government Auxiliary Farm, Oderolal	362	Ditto		
	Government Auxiliary Farm, Dadu	584	Ditto		
	Government Fruit Farm, Mirpurkhas	60	Horticulturist		

Sind	Fruit Sub-Station, Larkana	60	Manager	Chief Agricultural Officer in Sind.
	Government Seed Farm, Mirpurkhas	200	Cotton Breeder and Officer-in-charge.	
	Jamesabad Sub-Station	29	Inspector of Agriculture, Mirpurkhas.	
	Sakrand Chemical Section	11	Agricultural Chemist and Soil Physicist.	
	Physiological Section	6	Cotton Physiologist of Sakrand.	
	Agricultural Research Station, Sakrand	234	Officer-in-charge, Sakrand	
Bengal	Chinsurah	210	Farm Superintendent, Chinsurah.	Deputy Director of Agriculture, Western Circle.
	Berhampore	44	District Agricultural Officer, Berhampore.	Ditto.
	Bankura	29	District Agricultural Officer, Bankura.	Ditto.
	Suri	35	District Agricultural Officer, Suri.	Ditto.
	Krishnagar	53	District Agricultural Officer, Nadia.	Ditto.
	Gosaba (24-Parganas)	8	Agricultural Demonstrator, Gosaba.	Ditto.
	Jessore Khas Mahal Farm	5	District Agricultural Officer, Jessore.	Ditto.
	Burdwan	35	District Agricultural Officer, Burdwan.	Ditto.
	Rajshahi	63	Farm Superintendent, Rajshahi.	Deputy Director of Agriculture, Northern Circle.
	Pabna	19	District Agricultural Officer, Pabna.	Ditto.
	Bogra (Main Farm)	23	District Agricultural Officer, Bogra.	Ditto.
	Bogra (Branch Farm)	6	Ditto	Ditto.
	Malda	16	District Agricultural Officer, Malda.	Ditto.
	Dinajpur	24	District Agricultural Officer, Dinajpur.	Ditto.

List of Agricultural Stations in India in 1933-34 and 1934-35—contd.

Province	Agricultural Stations	Area in acres	Officer in immediate charge	Supervising Officer	REMARKS
Bengal—*contd.*	Rangpur Demonstration Farm	19	District Agricultural Officer, Rangpur.	Deputy Director of Agriculture, Northern Circle.	
	Mainaguri	25	District Agricultural Officer, Jalpaiguri.	Ditto.	
	Government Tobacco Farm, Rangpur	52	Farm Superintendent, Government Tobacco Farm, Rangpur.	Agricultural Chemist, Bengal.	
	Dacca Central Farm	354	Chief Farm Superintendent, Dacca.	Deputy Director of Agriculture, Eastern Circle.	
	Jaidebpur Farm (Court of Wards)	11	Agricultural Demonstrator, Jaidebpur.	Ditto.	
	Mymensingh Farm	20	District Agricultural Officer, Mymensingh.	Ditto.	
	Jamalpur	35	Ditto	Ditto.	
	Kishoreganj Farm	83	Ditto	Ditto.	
	Dhanbari Farm	7	Ditto	Ditto.	
	Gayhatta C. W. Farm	4	Agricultural Demonstrator	Ditto.	
	Baratia Private Farm	8	Ditto	Ditto.	
	Faridpur Farm	20	District Agricultural Officer, Faridpur.	Ditto.	
	Rajbari Farm	10	Ditto	Ditto.	
	Barisal Farm	20	District Agricultural Officer, Barisal.	Ditto.	
	Rangamati Farm	51	District Agricultural Officer, Rangamati.	Director of Agriculture, Bengal.	
	Charbadna Farm	66	District Agricultural Officer, Barisal.	Deputy Director of Agriculture, Eastern Circle.	
	Comilla Farm	20	District Agricultural Officer, Comilla.	Ditto.	
	Brahmanbaria Private Farm	5	Agricultural Demonstrator, Brahmanbaria.	Ditto.	

	Durgapur H. E. School Farm	5	Agricultural Teacher attached to School.	Deputy Director of Agriculture, Eastern Circle and District Agricultural Officer, Chittagong.
	Kalimpong Farm	75	Superintendent of Agriculture, Kalimpong.	Director of Agriculture, Bengal.
United Provinces	Shahjahanpur	165	Superintendent	Economic Botanist (Sugar and Paddy) to Government, United Provinces.
	Nagina (Bijnor)	76	Research Specialist	Ditto.
	Budaun	19	Farm Superintendent	Deputy Director of Agriculture, Rohilkhand and Kumaun Circle, Bareilly.
	Nawabgunj (Bareilly)	120	Ditto	Ditto.
	Nigohi Farm	30	Ditto	Ditto.
	Jeolikote (Naini Tal)	51	Ditto	Ditto.
	Tarikhet	17	Ditto	Ditto.
	Atarra (Banda)	171	Ditto	Divisional Superintendent of Agriculture, Bundelkhand Circle.
	Bela Tal (Hamirpur)	30	Ditto	Ditto.
	Etawah	61	Ditto	Ditto.
	Bichpuri (Agra)	100	Ditto	Ditto.
	Fyzabad	206	Ditto	Deputy Director of Agriculture, Eastern Circle, Partabgarh.
	Partabgarh	90	Ditto	Assistant Deputy Director of Agriculture, Eastern Circle.
	Benares	78	Ditto	Divisional Superintendent of Agriculture, Eastern Circle.
	Kalai (Aligarh)	143	Ditto	Deputy Director of Agriculture, Western Circle.
	Bulandshahr	25	Ditto	Ditto.
	Muzaffarnagar	101	Ditto	Assistant Deputy Director of Agriculture, Western Circle.
	Meerut	76	Ditto	Ditto.
	Mainpuri	53	Ditto	Divisional Superintendent of Agriculture, Western Circle.

List of Agricultural Stations in India in 1933-34 and 1934-35—contd.

Province	Agricultural Stations	Area in acres	Officer in immediate charge	Supervising Officer	REMARKS
United Provinces—*contd.*	Gorakhpur	110	Farm Superintendent	Deputy Director of Agriculture, North-Eastern Circle, Gorakhpur.	
	Bahraich	102	Ditto	Divisional Superintendent of Agriculture, North-Eastern Circle.	
	Kalianpore (Cawnpore)	263	Ditto	Deputy Director of Agriculture, Sarda Circle, Lucknow.	
	Hardoi	55	Ditto	Divisional Superintendent of Agriculture, Sarda Circle.	
	Palhri (Bara Banki)	30	Ditto	Assistant Deputy Director of Agriculture, Sarda Circle.	
	Haidargarh (Bara Banki)	16	Ditto	Ditto.	
	Turner (Rae-Bareli)	12	Ditto	Ditto.	
	Uno	42	Ditto	Ditto.	
	Agricultural Station, Lyallpur	431	Agricultural Assistant	Deputy Director of Agriculture, Lyallpur.	Experimental Farm.
	Botanical Farm, Lyallpur	36	Cerealist	Cerealist, Punjab Agricultural College, Lyallpur.	Experiments with cereals.
	Cotton Research Station, Lyallpur	18	Assistant to Cotton Research Botanist.	Cotton Research Botanist, Lyallpur.	Breeding plot.
	Cotton Research Farm, Risalewala	230	Ditto	Ditto	Agronomic and extensive trials.
	Students Farm, Lyallpur	82	Assistant Professor of Agriculture (2nd).	Professor of Agriculture, Punjab, Lyallpur.	For practical training to students.
	Dairy Farm, Lyallpur	26	Dairy Manager	Ditto	Ditto.
	Botanical Farm, Lyallpur	10	Professor of Botany	Professor of Botany, Punjab Agricultural College, Lyallpur.	For spice crops, root-rot experiments and various diseases.
	Botanical Sub-Station, Sirsa	410	Millet Botanist and Fodder Specialist.	Ditto	Botanical Experiments.

Punjab	Fruit Farm, Lyallpur	25	Agricultural Assistant	Fruit Specialist	Experiment with fruits.
	Fruit Farm, Risalewala	743	Ditto	Deputy Director of Agriculture, Lyallpur.	Mainly a seed farm.
	Jhang Farm	200	Ditto	Ditto	District Farm.
	Kala Shah Kaku Rice Farm	384	Assistant Cerealist	Ditto	Rice Breeding Station.
	Montgomery Agricultural Station	681	Agricultural Assistant	Deputy Director of Agriculture, Montgomery.	Experimental Farm.
	Shergarh Farm	1,549	Ditto	Ditto	Seed Farm.
	Fatna Farm	528	Ditto	Ditto	Ditto.
	Multan Farm	528	Ditto	Deputy Director of Agriculture, Multan.	Experimental and Seed Farm.
	Vihari Farm	500	Ditto	Ditto	Seed Farm.
	Gurdaspur Agricultural Station	263	Ditto	Deputy Director of Agriculture, Gurdaspur.	Experimental Farm.
	Beas Farm	36	Ditto	Ditto	District Farm.
	Attari Farm	101	Ditto	Ditto	Ditto.
	Gujranwala Farm	107	Ditto	Ditto	Ditto.
	Rawalpindi Agricultural Station	252	Ditto	Deputy Director of Agriculture, Rawalpindi.	Experimental Station.
	Campbellpur Farm	100	Ditto	Ditto	District Farm.
	Gujarat Farm	47	Ditto	Ditto	Ditto.
	Chillianwala Seed Farm	250	Ditto	Ditto	Seed Farm.
	Sargodha Old Seed Farm	155	Ditto	Ditto	Ditto.
	Sargodha New Seed Farm	492	Ditto	Ditto	Ditto.
	Mianwali Farm	162	Ditto	Ditto	District Farm.
	Hansi Agricultural Station	589	Ditto	Deputy Director of Agriculture, Hansi.	Experimental Station.
	Sirsa Seed Farm	400	Ditto	Ditto	Seed Farm.
	Ferozepore Farm	100	Ditto	Ditto	District Farm.
	Gurgaon Farm	100	Ditto	Ditto	Ditto.
	Rohtak Farm	100	Ditto	Ditto	Ditto.

List of Agricultural Stations in India, 1933-34 and 1934-35—contd.

Province	Agricultural Stations	Area in acres	Officer in immediate charge	Supervising Officer	REMARKS
		1934-35.			
Punjab—*contd.*	Rohtak Dry Farming Research Station	100	Agricultural Assistant	Deputy Director of Agriculture, Hansi.	Dry Farming Research Station.
	Ambala Farm	100	Ditto	Ditto	District Farm.
	Karnal Farm	100	Ditto	Ditto	Ditto.
	Ludhiana Farm	54	Ditto	Deputy Director of Agriculture, Jullundur.	Ditto.
	Kangra plot	10	Ditto	Ditto	Agricultural Plot.
	Jullundur Agricultural Station	121	Ditto	Ditto	Experimental Farm.
Burma	Mandalay	630	Farm Superintendent	Assistant Director of Agriculture, and Officer-in-charge of the Agricultural College Farm, Mandalay.	
	Mahlaing	254	Ditto	Deputy Director of Agriculture, Myingyan Circle, Meiktila.	
	Pyinmana	55	Ditto	Deputy Director of Agriculture, East Central Circle, Pyinmana.	
	Allanmyo	144	Ditto	Deputy Director of Agriculture, West Central Circle, Magwe.	
	Hmawbi	456	Ditto	Rice Research Officer, Rangoon	
	Myaungmya	92	Ditto	Deputy Director of Agriculture, Irrawaddy Circle, Bassein.	
	Mudon	88	Ditto	Deputy Director of Agriculture, Tenasserim Circle, Moulmein.	
	Akyab	138	Ditto	Deputy Director of Agriculture, Arakan Circle, Akyab.	
	Kanbalu	534	Ditto	Deputy Director of Agriculture, Northern Circle, Mandalay.	
	Tatkon	106	Ditto	Deputy Director of Agriculture, East Central Circle, Pyinmana.	

	Sa-aing	11	Ditto	Deputy Director of Agriculture, West Central Circle, Magwe.	
	Kyaukpyu	23	Ditto	Deputy Director of Agriculture, Arakan Circle, Akyab.	
	Paukkoung	16	Ditto	Entomologist, Mandalay.	
Bihar and Orissa	Cuttack	150	Manager	Assistant Director of Agriculture, incharge of Orrisa Range.	
	Khurda	31	Overseer		
	Balasore	75	Do.		
	Angul	47	Do.		
	Puri	42	Do.		
	Kujang	30	Do.		
	Sambalpur	32	Do.		
	Sepaya	379	Manager	Deputy Director of Agriculture, North Bihar Range.	
	Siwan	20	Overseer	Deputy Director of Agriculture, North Bihar Range.	
	Darbhanga	26	Do.		
	Purnea	60	Assistant Director of Agriculture.	....	Tournament Trust Farm.
	Byreah	316	Farm Manager	Manager, Bettiah Raj Court of Wards Farm.	
	Sabour	150	Manager	Assistant Director of Agriculture, incharge of South-East Bihar Range.	
	Jamui	38	Overseer		
	Banka	26	Do.		
	Patna	200	Manager	Deputy Director of Agriculture, South Bihar Range.	
	Gaya	95	Overseer		
	Nawadah	88	Do.		
	Bikramganj	24	Do.		
	Siris	35	Do.		
	Kanke	340	Manager	Assistant Director of Agriculture, incharge, Chota Nagpur Range.	
	Netarhat	193	Overseer		

List of Agricultural Stations in India, 1933-34 and 1934-35—contd.

Province	Agricultural Stations	Area in acres	Officer in immediate charge	Supervising Officer	REMARKS.
Bihar and Orissa—*contd.*	Purulia	52	Overseer	Assistant Director of Agriculture, incharge, Chota Nagpur Range.	
	Chianki	32	Do.		
	Chaibassa	38	Do.		
Central Provinces	Akola	272	Superintendent	Economic Botanist for Cotton, C. P.	Experimental Farm.
	Chindwara	69	Do.	Deputy Director of Agriculture	Ditto.
	Powarkhera	528	Do.	Ditto	Ditto.
	Adhartal	299	Do.	Ditto	Ditto.
	Nagpur	286	Extra Assistant Director	Principal, Agricultural College, Nagpur.	Ditto.
	Labhandi	229	Do.	Deputy Director of Agriculture	Ditto.
	Waraseoni	63	Superintendent	Ditto	Seed and Demonstration Farm.
	Betul	160	Do.	Ditto	Ditto.
	Bilaspur	253	Do.	Ditto	Ditto.
	Buldana	135	Do.	Ditto	Ditto.
	Drug	281	Do.	Ditto	Ditto.
	Khandwa	177	Do.	Ditto	Ditto.
	Chandkhuri	111	Do.	Ditto	Ditto.
	Seoni	170	Do.	Ditto	Ditto.
	Yeotmal	106	Do.	Ditto	Ditto.
	Saugor	161	Do.	Ditto	Cattle Breeding Farm. The farm is attached to the Demonstration Farm, Drug.
	Drug	..	Do.	Ditto	Ditto.
	Ellichpur	300	Do.	Ditto	Cattle Breeding and Dairy Farm.

	Powarkhera	..	Do.	Ditto	Cattle Breeding Farm. Attached to the Experimental Farm, Powerkhera.
	Adhartal	339	Do.	....	Cattle Breeding Farm.
	Telinkheri	1,000	Do.	Deputy Director of Agriculture	Cattle Breeding and Dairy Farm.
	Chandkhuri	..	Do.	Ditto	Cattle Breeding Farm. Attached to the Demonstration Farm, Chandkhuri.
	Khandwa	..	Do.	Ditto	Cattle Breeding Farm. Attached to the Demonstration farm, Khandwa.
	Garhi	1,617	Do.	Ditto	Cattle Breeding Farm.
	Bod	2,906	Do.	Ditto	Ditto.
	Pendra	2,500	Do.	Ditto	Ditto.
	Borgaon	379	Do.	Ditto	Ditto.
	Bilaspur	..	Do.	Ditto	Attached to the Demonstration Farm, Bilaspur.
Assam	Upper Shillong	521	Farm Manager	Deputy Director of Agriculture, Livestock.	Cattle-breeding, potato and fodder crops.
	Khanapara	197	Ditto		Cattle-breeding and fodder crops.
	Jorhat	59	Ditto	Deputy Director of Agriculture, Upper Assam Valley.	Sugarcane.
	Titabar	125	Ditto		Rice.
	Karimganj	80	Ditto	Deputy Director of Agriculture, Surma Valley.	Do.
	Sylhet	210	Ditto	Deputy Director of Agriculture, Livestock.	Cattle-breeding and fodder crops.
	Habiganj	54	Ditto	Deputy Director of Agriculture, Surma Valley.	Deep Water Paddy.
	Shillong Fruit Garden	63	Fruit Inspector	Director of Agriculture, Assam	Fruit culture.
North-West Frontier Province	Tarnab	200	Farm Manager	Extra Assistant Director of Agriculture.	
	Haripur	16	Agricultual Assistant	Ditto	
	Naurang Sarai (Bannu District)	100	Farm Manager	Extra Assistant Director of Agriculture, Southern Circle.	

List of Agricultural Stations in India, 1933-34 and 1934-35—contd.

Province	Agricultural Stations	Area in acres	Officer in immediate charge	Supervising Officer	REMARKS
Baluchistan	Quetta	25	Assistant Pomologist	Agriculture Officer in Baluchistan.	
	Usta	300	Agricultural Assistant, Usta.	Ditto	
Hyderabad	Himayatsagar—Hyderabad	299	Farm Superintendent	Deputy Director of Agriculture, West Telingana.	Main Experimental Farm.
	Warangal	104	Ditto	Deputy Director of Agriculture, East Telingana.	Ditto.
	Raichur	116	Ditto	Deputy Director of Agriculture, Karnatic.	Ditto.
	Parbhani	265	Ditto	Deputy Director of Agriculture, Godavari.	Ditto.
	Sangareddy	78	Ditto	Deputy Director of Agriculture, West Telingana.	Experimental Farm.
	Rudrur	65	Ditto	Ditto	Ditto.
	Mahbubnagar	76	Ditto	Ditto	Demonstration Farm.
	Himayatsagar	464	Ditto	Director of Agriculture	Cattle Breeding Farm.
	Himayatsagar	..	Ditto	Deputy Director of Agriculture, West Telingana.	Poultry Farm. (Piot reserved on the Main Farm, Himayatsagar).
Mysore	Agricultural Experimental Farm, Hebbal, Bangalore.	300	Farm Manager	Deputy Director of Agriculture, Bangalore.	
	Marthur Farm (Shimoga District)	106	Agricultural Inspector	Assistant Director of Agriculture, Shimoga.	
	Hiriyur Farm	218	Farm Manager	Director of Agriculture, Mysore	
	Paddy-breeding Station, Nagenahalli, Mysore District.	63	Junior Assistant Botanist.	Deputy Director of Agriculture, Bangalore.	

	Kar Ragi-breeding Station, Hunsur, Mysore District.	44	Ditto	Ditto	
	Coffee Experimental Station, Balehonnur, Kadur District.	120	Farm Manager	Senior Assistant Director of Agriculture, Chikmagalur.	....
	Cattle-breeding Station (Main and Sub-Stations), Ajjampur, Kadur District.	800	Manager	Livestock Expert, Bangalore	....
	Yellachihalli Sheep Farm	500	Agricultural Inspector	Ditto	....
	Irwin Canal Farm, Mandya	650	Superintendent	Director of Agriculture, Mysore	....
Baroda	Baroda Agricultural Station	84	Superintendent	Director of Agriculture.	
	Jagudan Agricultural Station	18	Do.	Ditto.	
	Amreli Agricultural Station	56	Do.	Ditto.	
	Vyara	16	Do.	Ditto	Sugarcane Investigation Station.
Travancore	Nagercoil	40	Agricultural Inspector	Director of Agriculture and Fisheries	Paddy Farm.
	Cape Comorin	16	Agricultural Sub-Inspector.	Ditto	Fruit Farm.
	Trivandrum	90	Agricultural Inspector	Ditto	Cattle Farm.
	Kottarakara	200	Headmaster	Ditto	Agricultural School Farm.
	Koni	150	Agricultural Inspector	Agricultural Inspector, Kottarakara Circle.	Pepper Farm.
	Puliara	35	Ditto	Ditto	Demonstration Farm.
	Oachira	4	Agricultural Demonstrator.	Agricultural Inspector, Mavelikara.	Coconut Farm.
	Alleppey	9	Ditto	Agricultural Inspector, Vaikom	Coconut Experimental Farm.
	Alwaye	13	Agricultural Sub-Inspector.	Director of Agriculture and Fisheries.	Demonstration Farm.
Cochin	Central Farm, Ollukkara, Trichur Taluk	400	Manager, Central Farm	Director of Agriculture.	
	Coconut Station, Vyttila, Ernakulam, Cochin, Kanayannur Taluk.	25	Agricultural Inspector, Cochin, Kanayannur.	Ditto.	

List of Agricultural Stations in India, 1933-34 and 1934-35—contd.

Province	Agricultural Stations	Area in acres	Officer in immediate charge	Supervising Officer	REMARKS
Bhopal	Central Research Farm, Nabibagh	100	Farm Superintendent	Director of Agriculture, Bhopal	This Farm has 40 acres under experiment and 60 acres for multiplication of improved seeds.
Gwalior	Gwalior	265	Manager, Central Experimental Farm.	Deputy Director of Agriculture, Gwalior Division.	
	Ujjain	760	Ditto	Deputy Director of Agriculture, Malwa Division.	
Jammu and Kashmir	Pratap Model Farm, Shallabagh	75	Manager	Director of Agriculture.	
	Golsummander Farm, Jammu	28	Inspector.	Ditto.	

APPENDIX III.

Staffs of Provincial and State Departments of Agriculture in India during 1933-34 and 1934-35.

Province.	RESEARCH AND TEACHING STAFF.											
	SUPERIOR SERVICE				PROVINCIAL SERVICE				SUBORDINATE SERVICE			
	Sanctioned cadre		Filled substantively		Sanctioned cadre		Filled substantively		Sanctioned cadre		Filled substantively	
	1933-34	1934-35	1933-34	1934-35	1933-34	1934-35	1933-34	1934-35	1933-34	1934-35	1933-34	1934-35
Madras	4	4	3	3	22	23	22	23	109	109	100	109
Bombay Proper	2	2	2	2	17	17	17	17	106	106	106	106
Sind	2	2	2	2	5	8	5	6	78	128	78	128
Bengal	4	4	3	3	8	8	7	7	25	25	25	25
United Provinces	7	7	7 (*b*)	7 (*b*)	9	9	9	9	70	70	70	70
Punjab	15	14	13	14	18	24	18	22	117	122	117	122
Burma	..	..	2 (*a*)	2 (*a*)	9	8	6	6	19	19	15	15
Bihar and Orissa	2	2	..	..	7	7	7	7	3	3	2	2
Central Provinces and Berar	2	2	2	2	7	6	6	6	20	20	20	20
Assam	2	1	2	1	..	1	..	2	12	14	12	14
N.-W. F. Province	..	..	1	..	1	2	1	2	21	27	27	27
Baluchistan	1	1	1	1	4	5	3	5	8	5	3	5
TOTAL	41	39	38	37	107	118	101	112	583	648	584	643

Indian States.

Hyderabad	2	2	2	2	4	4	3	3	9	9	9	9
Mysore	..	..	..	..	15	15	15	14	64	64	64	64
Baroda	1	1	..	..	1 (*c*)	3	..	2	2	2 (*c*)	1	1
Travancore	..	..	..	..	..	..	..	..	9	9	9	9
Cochin	4	4	4	4	..	..	..	..	16 (*d*)	16 (*d*)	16 (*d*)	16 (*d*)
Bhopal	..	..	2	2	..	..	4	4	..	..	8	8
Gwalior	2	2	2	2	7	7	7	7	34	34	34	34
Kashmir	1	1	1	1	4	4	4	4	18	18	14	14

(*a*) These appointments are counted against the Post of Burma Agricultural Service, Class I.
(*b*) Includes 2 temporary posts in U. P. Agricultural Service, Class I.
(*c*) Paid from Indian Central Cotton Committee.
(*d*) 5 Posts on probation.

APPENDIX III-A.

Staffs of Provincial and State Departments of Agriculture in India during 1933-34 and 1934-35.

Province	DISTRICT STAFF											
	SUPERIOR SERVICE				PROVINCIAL SERVICE				SUBORDINATE SERVICE			
	Sanctioned cadre		Filled substantively		Sanctioned cadre		Filled substantively		Sanctioned cadre		Filled substantively	
	1933-34	1934-35	1933-34	1934-35	1933-34	1934-35	1933-34	1934-35	1933-34	1934-35	1933-34	1934-35
Madras	8	8	7	7	14	14	14	14	246	239	238	239
Bombay	3	3	3	3	8	8	8	8	110	110	110	110
Bengal	2	2	1	1	9	9	7	6	245*	249*	175	175
United Provinces	12	12	12 (*a*)	12 (*a*)	12	12	12 (*b*)	12 (*b*)	315	315	315	315
Punjab	8	9	7	8	18	19	18	19	369	369	369	369
Burma	..	..	8 (*c*)	8 (*c*)	17	17	9	9	82	82	63	66
Bihar and Orissa	9	9	3	3	16	17	13	16	124 (*x*)	124 (*z*)	98	103
Central Provinces	4	4	4 (*d*)	4 (*d*)	13	13	10	9	120	120	120	120
Assam	..	..	..	..	6	6	5	6	18	20	18	20
N.-W. F. Province	No separate staff											
TOTAL	46	47	45	46	113	115	96	99	1,629	1,628	1,506	1,517

Indian States.

Province	1933-34	1934-35	1933-34	1934-35	1933-34	1934-35	1933-34	1934-35	1933-34	1934-35	1933-34	1934-35
Hyderabad	5	5	5	5	7	7	7	7	52	52	42	44
Mysore	..	..	..	..	15	15	15	15	377	377	377	377
Baroda	..	..	..	..	..	..	7	7	..	1	..	1
Travancore	..	..	..	..	..	..	..	..	26	26	26	26
Cochin	8	10	8	10	..	..	..	..	6	6	6	6
Bhopal	No separate staff											
Gwalior	No separate staff											
Jammu and Kashmir	1	1	1	1	4	4	4	4	18	18	14	14

* Including temporary Staff.
(*a*) Including 5 temporary posts in U. P. Class I.
(*b*) Including 3 posts of Garden Superintendents.
(*c*) These appointments are counted against the posts of Burma Agricultural Service, Class I.
(*z*) Funds not voted for 15 posts.
(*d*) Including Director of Agriculture.
(*x*) Funds not voted for 23 posts.

APPENDIX IV.

Showing results of well-boring in India during 1933-34 and 1934-35.

Province	1932-33		1933-34		1934-35	
	Number of bores	Number successful	Number of bores	Number successful	Number of bores	Number successful
(a) British India.						
Madras	899	652	1,047	679	1,175	769
Bombay Proper	1	1*	..	..	..	..
Sind	5	4	6	4	3	3
Bengal	39	39	89	83	191	180
United Provinces	1,714	1,217	1,806	1,319	1,824	1,433
Punjab	441	409	263	240	276	239
Burma	1	..	..	..	..	..
Bihar and Orissa	218	192	216	177	206	227
N.-W. F. P.	..	..	..	..	2	2
TOTAL	3,318	2,514	3,427	2,502	3,767	2,853
(b) Indian States.						
Hyderabad (Deccan)	56	47	43	43	45	45
Mysore	18	9	39	33	39	33
Barodo	42	30	4	30	53	33
Gwalior	16	16	9	9	7	7

* Boring operations closed as a measure of retrenchment.

APPENDIX V.

Showing sale of improved implements through departmental agency in India during 1933-34 and 1934-35.

Province	PLOUGHS			CANE MILLS			FODDER CUTTERS		
	1932-33	1933-34	1934-35	1932-33	1933-34	1934-35	1932-33	1933-34	1934-35
(a) British India.									
Madras	1,172	2,680	2,945	49	212	62	8	2	2
Bombay Presidency Proper	366	456	687	83	47	85	..	..	1
Sind	364	330	570	..	..	..	..	..	..
Bengal*	45	34	40	11	6	12	1	1	1
United Provinces	2,550	4,056	4,531	554	310	597	685	808	1,671
Punjab	5,990	1,769	3,515	5,300	1,969	3,202	19,550	21,758	26,070
Burma	4,263	5,066	4,877	16	24	29	22	2	..
Bihar and Orissa	598	233	478	30	34	8	..	434	441
Central Provinces and Berar	1,835	1,670	2,939	240	176	184	15	22	6
Assam	..	2	..	85	121	90	..	..	..
North-West Frontier Province	..	85	77	..	5	108	..	67	72
TOTAL	17,183	16,381	20,659	6,368	2,910	4,377	20,281	23,094	28,264
(b) Indian States.									
Hyderabad	228	246	559	47	28	48	11	4	46
Mysore	1,853	1,797	2,078	106	166	126	..	..	..
Baroda	26	10	52	2	..	..	1	..	..
Travancore	2	..	..	..	..	..	..	..	..
Cochin	4	..	..	..	..	..	..	..	..
Bhopal	..	..	5	..	..	..	..	..	..
Gwalior	..	..	..	..	..	..	..	..	..

* 3,550 sugarcane crushing mills were supplied on hire system during 1934-35 by Messrs. Renwick & Co., Kusthia, in the Eastern Circle.

Showing sale of improved implements through departmental agency in India during 1933-34 and 1934-35—contd.

Province	HOES			OTHER IMPLEMENTS			SPARE PARTS		
	1932-33	1933-34	1934-35	1932-33	1933-34	1934-35	1932-33	1933-34	1934-35
(a) British India.									
Madras	45	48	66	1,015	317	689	1,743	2,065	2,639
Bombay Presidency Proper	10	6	19	12,236	3,257	2,580	1,159	1,633	1,099
Sind	2	100	60	92	118	199	45	..	59
Bengal*	..	1	1	49	12	6	16	10	5
United Provinces	86	33	274	1,023	647	786	9,229	8,665	10,188
Punjab	25	292	221	1,520	2,146	1,422	3,780	4,893	5,678
Burma	133	12	27	714	440	711	655	..	..
Bihar and Orissa	228	330	417	740	185	319	304	722	1,236
Central Provinces and Berar	35	399	400	1,259	1,154	2,499	18,596	21,991	29,631
Assam	..	14	..	13	64	27	16	115	133
North-West Frontier Province	..	7	1	..	205	120	..	..	89
TOTAL	564	1,242	1,486	18,661	8,545	9,358	35,543	40,094	50,757
(b) Indian States.									
Hyderabad	22	73	350	98	968	478	54	33	48
Mysore	115	241	336	492	439	200	4,403	4,658	5,602
Baroda	..	..	..	15	..	..	..	1	..
Travancore	..	..	..	102	..	25	2	..	..
Cochin	..	..	..	114	58	48	..	..	..
Bhopal	..	..	10	..	..	25	..	..	..
Gwalior	..	..	..	255	286	273†	..	..	..

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* 3,550 sugarcane crushing mills were supplied on hire system during 1934-35 by Messrs. Renwick & Co., Kusthia, in the Eastern Circle.

† Figure represents the total of all kinds of implements sold.

APPEN

Improved seeds and manures distributed through departmental

Province	SEED DIS-					
	SEED GAIN IN CWT.			NUMBER OF WHOLE CANES EXCEPT WHERE OTHERWISE STATED		
	1932-33	1933-34	1934-35	1932-33	1933-34	1934-35
						(a) British
Madras	16,890	267,152	275,642	355,803	156,043	144,762
Bombay Presidency Proper	13,476	26,659	29,303	10,201,670	11,012,127 192,000*	509,043 63,000*
Sind	2,749	15,067	16,331	498	634	198
Bengal	38	3,485	6,008	4,200,605	4,386,902	12,683,440
United Provinces	185,487	172,422	186,739	1,311,170 Cwts.	987,826 Cwts.	1,657,744 Cwts.
Punjab	38,768	130,258	169,660	(*a*)	..	..
Burma	111,998	105,139	138,712	477,000	980,175	1,260,810
Bihar and Orissa	4,945	6,709	4,728	310,910 canes *plus* 110 Cwts.	121,983	70,923
Central Provinces	242,199	253,405	241,587	1,987,519	2,114,440	2,298,933
Assam	3,049	909	1,606	124,874*	74,228*	116,355*
North-West Frontier Province	342	784	5,213	4,973	125	..
Baluchistan	..	..	..	..	..	..
TOTAL	619,941	982,079	1,075,529	..	..	..
						(b) Indian
Hyderabad	29,301	16,757	8,432	1,269	3,149	4,492
Mysore	4,010	4,197	4,753	2,449,397	5,268,678	20,427,336
Baroda	..	82	379	..	..	15,515*
Travancore	236	301	380	5,855*	14,012*	18,100
Cochin	78	103	138	4,065 canes *plus* 4,537 setts	4,299 canes *plus* 716 setts	4,252 canes *plus* 8,966 setts
Bhopal	215	215	135	..	..	13,830
Gwalior	1,094	1,227	1,338	266,440	628,300	560,000
Kashmir	805	820	..	..	..	..

(*a*) The Department does not stock sugarcane seed for sale apart from such areas as are available from its
(*b*) Artificial manures are supplied to Zamindars directly by manufacturers and no record of the sales is
* Setts.

DIX VI.

agency in India during 1933-34 and 1934-35.

TRIBUTED			MANURES DISTRIBUTED					
FRUIT PLANTS NUMBER			COMMERCIAL FERTILIZERS IN CWT.			OIL CAKES IN CWT.		
1932-33	1933-34	1934-35	1932-33	1933-34	1934-35	1932-33	1933-34	1934-35
India.								
129,480	69,836	162,460	1,316	20	151	1,329	137	274
73,475	111,335	87,917	12,082	10,447	14,364	2,393	7,576	9,087
7,943	21,258	31,602	..	..	13	..	..	..
12	173	1,475	281	1,021	343	248	240	266
10,920	9,079	10,126	14,018	34,675	44,037	20,449	23,035	21,748
..	..	..	(*b*)	..	..	..	..	..
7,625	5,167	2,395	3,150	1,459	3,477	..	..	..
3,313	1,567	3,061	18,491	4,058	21,062	..	..	..
..	..	..	..	..	..	..	..	..
3,545	1,767	2,018	828	464	9	119	36	56
12,784	16,142	21,371	..	2	12	..	..	..
1,825	5,682	4,872	..	..	..	..	..	..
250,922	242,006	327,297	50,166	52,156	83,468	24,538	31,074	31,431
States.								
28	398	12,901	569	1,065	281	510	5,594	1,541
5,160	5,121	6,143	10,374	19,310	94,732	452	2,718	4,095
..	3,062	2,421	..	206	26	..	..	..
632	968	1,208	No direct sales by the Department.					
4,272	2,920	1,630	284	220	186	288	350	294
..	..	..	..	..	8	..	..	..
18,000	13,300	11,850	144	142	385	..	..	..
159,355	164,007	180,306	3	3	3	..	..	..

seed farms.
available,

APPENDIX VII.

Demonstraiton and propaganda work in India during 1933-34 and 1934-35.

Province	NUMBER OF AGRICULTURAL SHOWS HELD			NUMBER OF PRACTICAL DEMONSTRATIONS CARRIED OUT			NUMBER OF ILLUSTRATED LECTURES GIVEN		
	1932-33	1933-34	1934-35	1932-33	1933-34	1934-35	1932-33	1933-34	1934-35
(a) British India.									
Madras	199	357	278	14,915	12,216	19,042	495	507	450
Bombay Presidency Proper	98	67	61	1,637	1,560	1,754	500	410	471
Sind	6	24	31	271	586	656	10	8	14
Bengal	31	37	53	2,709	2,256	3,510	191	242	608
United Provinces	131	146	111	23,966	8,203	10,376	141	1,470	1,509
Punjab	..	216	299	..	8,143	9,109	..	207	873
Burma	12	3	3	1,590	2,796	2,643	131	116	216
Bihar and Orissa	20	17	21	8,441	10,115	14,572	21	20	37
Central Provinces and Berar	28	49	64	4,709	5,572	6,234	701	578	482
Assam	1	4	6	3,169	4,054	3,258	23	14	..
North-West Frontier Province	10	10	2	967	806	282	..	18	79
Baluchistan	..	..	..	..	50	50	..	..	..
TOTAL	536	930	929	62,374	56,357	71,486	2,213	3,590	4,739

(b) Indian States.

Hyderabad	35	111	170	924	1,288	1,911	34	177	134
Mysore	41	39	51	1,123	1,418	1,648	184	163	158
Baroda	..	8	2	..	12	9	..	..	..
Travancore	3	3	4	140	154	201	27	39	41
Cochin	3	3	5	67	176	287	6	10	2
Bhopal	1	1	1	15	26	44	..	..	..
Gwalior	9	5	7	..	..	..	..	..	..
Kashmir	1	1	1	69,516 fruit trees sprayed *plus* demonstration of pruning and planting and on manure shown in 300 villages.	217,675 fruit trees sprayed *plus* demonstration of pruning and planting and on manure shown in 394 villages.	307,414 fruit trees sprayed.	8	9	62

APPENDIX

Agricultural Colleges and Schools

Name of college or school	Courses of instruction	1932-33			
		Applications for admission	Admissions made during the year	Total number on the roll	Number passed in final examination
					(a) BRITISH
					(i) Post-graduate
Imperial Institute of Agricultural Research, Pusa.	(1) Two-year Post-graduate course.	..	13	(a) 18	4
	(2) One-year Post-graduate course in farm management and organization and general farm engineering.	33	3	4	1
	(3) Special Course .	33	7	8	8
Imperial Institute of Animal Husbandry and Dairying, Bangalore.	(1) Fifteen-month Post-graduate course.	4	2	2	1
	(2) Two-year Indian Dairy Diploma Course.	..	..	19	..
	(3) Short-course . .	3	3	3	3
	(4) Vocational training .	15	15	15	27
Imperial Cane-Breeding Station, Coimbatore.	No regular Course, but facilities given to study the methods of cane-breeding.	..	..	..	..
					(ii) Provincial Agri
Agricultural College, Coimbatore.	B.Sc. (Ag.) Degree Course of the Madras University.	180	45	137	48
Agricultural College, Poona	Three-years' Degree Course.	83	45	145	77
Agricultural College, Cawnpore.	Intermediate in Agriculture.	103	41	78	27
	B.Sc. Agri. . . .	17	9	81	28
Punjab Agricultural College, Lyallpur.	Four-year B.Sc. (Ag.) Degree Course.	76(a)	59	171	47
	One-and-a-half year M.Sc. Degree Course.	2	2	3	1
	Two-year Leaving certificate Course.	..	..	8	8

VIII.

in India during 1933-34 and 1934-35.

INDIA.

Training Institutes.

1933-34				1934-35				REMARKS
Applications for admission	Admissions made during the year	Total number on the roll	Number passed in final examination	Applications for admission	Admissions made during the year	Total number on the roll	Number passed in final examination	
24	7	(b) 19	1	32	10	(b) 27	10	(a) Two left without completing the course. (b) One left without completing the course.
	1	4	3		3	4	1	
..	9	9	9	..	11	11	11	
4	3	3	1	4	2	3	3	
31	21	19	15	..	..	21	..	
8	8	8	8	6	6	6	4	
15	15	15	11	12	12	12	15	
..	..	..	..	..	..	..	..	

cultural Colleges.

1933-34				1934-35				REMARKS
Applications for admission	Admissions made during the year	Total number on the roll	Number passed in final examination	Applications for admission	Admissions made during the year	Total number on the roll	Number passed in final examination	
139	40	124	40	91	28	104	31	
114	62	158	51	112	*103	169	42	* This number was actually admitted in June 1934 but the position was changed in July and the actual number on the First year Sc. (Agri.) roll is 80.
118	54	81	32	115	50	78	36	
7	7	75	36	14	4	73	29	
(a) 98	81	141	37	(a) 137	82	145	*16	(a) Total number of applications received for admission to Lower Course class and Degree Course. * 12 students under compartments excluded.
12	9	10	..	8	5	9	2	
..	..	9	7	..	..	17	14	

APPENDIX

Agricultural Colleges and Schools

Name of college or school	Courses of instruction	1932-33			
		Applications for admission	Admissions made during the year	Total number on the roll	Number passed in final examination
(*a*) BRITISH					
(ii) Provincial Agri-					
Punjab Agricultural College, Lyallpur—*contd.*	Six-months Summer Vernacular Course.	..	14	13	11
	Six-months Winter Vernacular Course.	..	12	5	5
	Ten-months Teachers' training Course.	17	12	12	12
	Six-months Vernacular Course in Dairying.	54	10	10	6
	Six-weeks Course in *Lohar* class.	69	20	19	19
	Two-weeks summer Course in Fruit and Vegetable Preservation.	..	..	..	..
	Two-weeks Fruit Culture Course.	..	..	..	..
	Two-weeks Winter Fruit Preservation Course.	..	..	..	..
	Six-months Post-graduate Course in Sugar Chemistry, Lyallpur.	(*d*)	..	..	..
	Six-months Post-graduate Course in Sugar Chemistry, Jullundur.	(*d*)	..	..	..
Agricultural College, Mandalay.	Three-years' Diploma Course.	..	..	18	16
Agricultural College, Nagpur	Four-year Degree Course	75	32	111	24
(iii) Agricultural					
Madras					
School for Juveniles at Coimbatore.	I and II Standard in Tamil, Arithmetic, Geography and Agriculture.	..	40	39	..
School for Juveniles at Palur near Nellikuppam.	Ditto I-V Standard in Tamil.	13	13	25	3
School for Juveniles at Anakapalle.	Ditto in Telugu . .	15	8	32	25
Bombay.					
Vernacular Agricultural School, Devihosur.	Two-years' course in Kanarese.	81	16	28	14
Vernacular Agricultural School, Dhulia.	Two-years course . .	42	15	31	15
Bengal.					
Secondary Agricultural School, Dacca.	Two-years course . .	120	16	28	22

VIII—*contd.*

in India during 1933-34 and 1934-35—contd.

1933-34				1934-35				REMARKS
Applications for admission	Admissions made during the year	Total number on the roll	Number passed in final examination	Applications for admission	Admissions made during the year	Total number on the roll	Number passed in final examination	
INDIA—*contd.*								
cultural Colleges—*contd.*								
(*b*)	42	20	14	(*b*)	48	84	26	
(*b*)	43	26	19	(*b*)	50	44	35	(*b*) Applications were received by respective Deputy Director of Agriculture.
32	14	14	14	37	14	14	(*c*) 13	
46	15	11	11	43	14	9	(*c*) 8	(*c*) One under-Compartment excluded.
38	28	21	21	27	27	19	17	
270	81	70	68	108	51	29	29	
41	41	16	16	31	31	12	12	(*d*) Includes for 1933-34, 3½ months at Jullundur. Includes for 1934-35, 8 months at Okara Military Farm.
58	32	21	21	24	24	13	13	
23	6	6	6	24	6	4	4	
..	..	(*e*) 2	1	..	..	..	..	(*e*) One left.
..	..	..	..	..	..	..	..	
65	37	118	19	74	44	130	26	
Schools.								
..	26	37	8	..	7	21	8	
10	10	27	6	16	16	30	6	
20	3	28	19	15	6	26	19	
52	15	26	8	80	17	30	13	
21	10	22	12	16	16	25	9	
131	18	31	14	226	17	32	13	

APPENDIX

Agricultural Colleges and Schools

(a) **BRITISH**

(iii) **Agricul-**

Name of college or school	Courses of instruction	1932-33			
		Applications for admission	Admissions made during the year	Total number on the roll	Number passed in final examination
United Provinces.					
Agricultural School, Bulandshahr.	(1) Two-years' diploma course.	61	30	59	28
	(2) Fieldmen course .	6	6	6	6
	(3) Farm Mechanic class	16	8	8	7
Agricultural School, Gorakhpur.	Two-years course . .	47	32	29	29
	Fieldmen course . .	19	5	5	5
Burma.					
Agricultural School, Pyinmana.	Four-years course and two-years course.	..	39	55	21
Farm School, Mahlaing .	9 months' course . .	73	12	11	11
Farm School, Hmawbi .	Ditto .	27	10	9	9
Training of Adult Cultivators	Short course . .	148	21	21	21
Central Provinces.					
Agricultural Anglo-Vernacular Middle School, Powarkhera (Hoshangabad).	Four-years course .	33	29	84	23

(b) **Indian**

Name of college or school	Courses of instruction	Applications for admission	Admissions made during the year	Total number on the roll	Number passed in final examination
Mysore State.					
Agricultural School, Hebbal	3 years . . .	156	38	84	21
Rama Krishna Krishisala, Anekal.	1 year	..	17	12	11
S. K. V. D. Patasala, Chikkanahalli.	1 year . . .	57	15	15	15
Agricultural School, Hassan	1 year	16	16	15	11

VIII—*contd.*

in India during 1933-34 and 1934-35—contd.

INDIA—*contd.*

tural Schools—*contd.*

1933-34				1934-35				REMARKS
Applications for admission	Admissions made during the year	Total number on the roll	Number passed in final examination	Applications for admission	Admissions made during the year	Total number on the roll	Number passed in final examination	
41	24	51	26	37	25	49	24	
10	7	7	7	8	8	8	8	
13	13	13	13	9	9	9	8	
37	24	20	25	34	22	20	20	
8	7	7	7	7	7	4	4	
..	39	64	8	..	38	74	12	
..	3	15	15	..	4	13	12	
..	..	10	10	..	8	8	8	
..	35	35	35	..	36	36	35	
42	32	81	12	30	26	85	14	

States.

1933-34				1934-35				REMARKS
Applications for admission	Admissions made during the year	Total number on the roll	Number passed in final examination	Applications for admission	Admissions made during the year	Total number on the roll	Number passed in final examination	
199	33	91	14	62	30	87	16	
..	17	14	14	..	12	11	11	
100	15	15	15	62	15	15	14	
22	17	17	12	21	21	21	16	

APPENDIX

Agricultural Colleges and Schools

Name of college or school	Courses of instruction	1932-33			
		Applications for admission	Admissions made during the year	Total number on the roll	Number passed in final examination
(a) BRITISH					
(b) Indian					
Baroda State.					
Agricultural School, Baroda	One-year certificate course. (Courses are possibly all practical in Agriculture, Horticulture, Poultry, Animal Husbandry, Health and Sanitation, Co-operation, Secondary occupations like carpentry, smithing and engineering, etc.).	..	..	..	..
Travancore.					
Agricultural School, Kottarakara.	Two-years' course . .	76	24	19	No examination.
Agricultural School, Koni .	Ditto .	..	..	52	48
Cochin.					
Government Agricultural School, Central Farm, Ollurkara, Trichur.	One year	15	15	15	15

VIII—*concld.*

in India during 1933-34 and 1934-35—concld.

INDIA—*concld.*

States—*contd.*

1933-34				1934-35				REMARKS
Applications for admission	Admissions made during the year	Total number on the roll	Number passed in final examination	Applications for admission	Admissions made during the year	Total number on the roll	Number passed in final examination	
159	25	25	25	90	25	21	21	The students are getting a stipend of Rs. 15 p. m. each from the Government and hence admission is restricted.
..	..	19	18	80	21	19	No examination.	
55	32	30	No examination.	..	..	28	14	
17	17	16†	15	..	..	..	..	† One left the School.

APPENDIX IX.

Operations of Non-credit Agricultural Co-operative Societies in India during 1933-34 and 1934-35.

(A) PURCHASE, SALE AND PRODUCTION.

Province	Class of Societies	1933-34						Remarks
		Number of Societies	Number of Members	Sale of goods to Members	Purchase of members' products	Working Capital	Profit (+) and loss (—) for the year	
				Rs.	Rs.	Rs.	Rs.	
Madras	Purchase and purchase and sale.	75	11,314	2,68,876	2,10,311	4,25,955	—3,086	
	Production and sale	10	796	18,418	33,547	1,11,830	—4,608	
	Others	340	21,574	..	..	4,17,292	—13,126	
	TOTAL	425	33,684	2,87,294	2,43,858	9,55,077	—20,820	
Bombay	Purchase and purchase and sale.	46	5,590	13,446	11,407	5,48,934	+9,872	
	Production	16	648	..	..	9,243	+54	
	Production and sale	52	10,963	1,08,042	2,80,846	11,49,051	+5,347	
	Others	134	55,335	37,055	1,297	6,75,320	+73,354	
	TOTAL	248	72,536	1,58,543	2,93,540	23,82,548	77,993	

Bengal	Purchase and purchase and sale.	74	9,365	2,17,887	1,20,490	5,59,304	+9,202	
	Production	937	22,907	..	..	4,77,012	—10,690	
	Production and sale	267	14,062	2,14,788	4,46,543	7,91,650	+1,12,054	
	Others	43	9,406	1,018	297	1,95,235	—3,197	
	TOTAL	1,321	55,740	4,33,693	5,67,330	20,23,201	+1,07,369	
United Provinces	Production and sale	148	4,304	76,300	1,56,884	56,112	17,578	
	Others	401	9,787	2,205	12	21,902	940	
	TOTAL	549	14,091	78,505	1,56,896	78,014	18,518	
Punjab	Purchase and purchase and sale.	17	1,398	1,03,687	96,186	74,233	4,469	
	Production	167	4,170	..	..	6,313	443	
	Production and sale	1,268	86,697	22,87,424	22,87,511	5,97,619	8,839	
	Others	88	1,732	..	..	89,644	6,123	
	TOTAL	1,540	93,997	23,91,111	23,83,697	7,67,809	19,874	
Burma	Purchase and purchase and sale.	11	688	..	..	31,144	+111	
	Production	5	50	..	..	..	..	Not working.
	Production and sale	11	1,348	1,345	..	1,46,946	—55,031	
	TOTAL	27	2,086	1,345	..	1,78,090	—54,920	

Operations of Non-credit Agricultural Co-operative Societies in India during 1933-34 and 1934-35—contd.

(A) PURCHASE, SALE AND PRODUCTION—*contd.*

Province	Class of Societies	1933-34						
		Number of Societies	Number of Members	Sale of goods to Members	Purchase of members' products	Working Capital	Profit (+) and loss (—) for the year	REMARKS
				Rs.	Rs.	Rs.	Rs.	
Bihar and Orissa	Production and purchase and sale.	1	22	..	..	2,935	—144	
	Production	*2	121	..	..	7,282	..	* Defunct Societies.
	Production and sale	1	41	..	1,469	4,128	—288	
	Others	5	267	..	..	2,108	+185	
	Grain golas	70	22,925	..	..	3,26,927	68,073	
	TOTAL	79	23,376	..	1,469	3,43,380	+67,826	
Central Provinces	Purchase and purchase and sale.	37	1,697	49,989	26,200	3,11,947	+8,640	
	Production	12	238	..	..	2,488	+232	
	Production and sale	9	736	443	..	25,866	+809	
	TOTAL	58	2,671	50,432	26,200	3,40,301	+9,681	

Assam	Production	1	216	..	..	2,992	—263
	Production and sale	23	454	17,649	15,152	20,703	+1,213
	TOTAL	24	670	17,649	15,152	23,695	+950
N.-W. F. Province	Production and sale	12	3,791	..	..	..	
Delhi	Production and sale	8	609	..	..	67	5
Mysore	Purchase and purchase and sale.	27	767	2,037	1,332	65,276	+632
	Production and sale	19	500	2,180	3,830	13,797	+631
	Others	49	1,739	..	..	9,927	+257
	TOTAL	95	3,006	4,217	5,162	89,000	+1,520
Baroda	Purchase and purchase and sale.	15	510	427	..	3,417	—28
	Production	29	1,111	4,197	5,500	1,20,022	6,006
	Production and sale	31	1,472	6,32,750	6,50,355	78,976	7,045
	Others	96	5,158	1,464	..	802	6,572
	TOTAL	171	8,251	6,38,838	6,55,855	2,03,217	19,595
Hyderabad	Purchase and purchase and sale.	9	615	1,54,183	1,28,605	92,745	+5,025

Operations of Non-credit Agricultural Co-operative Societies in India during 1933-34 and 1934-35—contd.

(A) PURCHASE, SALE AND PRODUCTION—*contd.*

Province	Class of Societies	1934-35						
		Number of Societies	Number of Members	Sale of goods to Members	Purchase of members' products	Working Capital	Profit (+) and loss (—) for the year	REMARKS
				Rs.	Rs.	Rs.	Rs.	
Madras	Purchase and purchase and sale.	76	11,850	2,62,669	3,13,023	7,19,023	+12,638	
	Production and sale	13	912	27,867	14,781	1,32,552	—9,226	
	Others	335	21,658	1,11,072	4,264	17,54,192	—83,057	
	TOTAL	424	34,420	4,01,608	3,32,068	26,05,767	—79,645	
Bombay	Purchase and purchase and sale.	56	6,962	33,247	4,29,678	6,62,945	16,627	
	Production	17	667	..	..	808	714	
	Production and sale	49	10,112	1,02,376	21,815	12,83,209	27,507	
	Others	138	54,939	54,038	5,649	9,15,966	63,674	
	TOTAL	260	72,680	1,89,661	4,57,142	28,62,928	1,07,094	

Bengal	Purchase and purchase and sale.	80	13,693	2,30,731	1,69,434	7,94,395	+12,180	
	Production	935	22,864	98	67,339	8,84,538	—5,292	
	Production and sale	250	13,733	1,82,095	3,47,465	9,46,280	+88,485	
	Others	46	9,937	1,922	1,430	2,55,530	—3,585	
	TOTAL	1,311	60,227	4,14,846	5,85,668	28,80,743	+91,788	
United Provinces	Production and sale	325	16,977	6,44,101	5,71,622	1,53,379	34,899	
	Others	453	10,716	201	..	34,873	753	
	TOTAL	778	27,693	6,44,302	5,71,622	1,88,252	35,652	
Punjab	Purchase and purchase and sale.	17	1,437	1,17,046	1,03,538	76,468	5,771	
	Production	185	4,490	..	..	5,101	583	
	Production and sale	1,351	98,291	7,02,885	25,77,939	6,08,097	—147	
	Others	93	1,949	..	..	99,198	1,223	
	TOTAL	1,646	106,167	8,79,931	26,81,477	7,88,864	7,430	
Burma	Purchase and purchase and sale.	1	300	687	..	31,094	—101	
	Production	5	50	..	..	..	..	Not working.
	Production and sale	10	1,241	2,311	..	1,10,253	—48,335	
	TOTAL	16	1,591	2,998	..	1,41,347	—48,436	

Operations of Non-credit Agricultural Co-operative Societies in India during 1933-34 and 1934-35—contd.

(A) PURCHASE, SALE AND PRODUCTION—*concld.*

Province	Class of Societies	1934-35						REMARKS
		Number of Societies	Number of Members	Sale of goods to Members	Purchase of members' products	Working Capital	Profit (+) and loss (—) for the year	
				Rs.	Rs.	Rs.	Rs.	
Bihar and Orissa	Purchase and purchase and sale.	3	197	219	..	715	—69	
	Production	1	99	..	..	6,753	..	
	Production and sale	1	43	..	..	3,995	+17	
	Others	6	347	..	..	2,435	+207	
	Grain golas	69	24,663	..	..	3,22,433	+23,101	
	TOTAL	80	25,349	219	..	3,36,331	+23,256	
Central Provinces	Purchase and purchase and sale.	39	1,752	73,343	59,992	3,26,336	+17,792	
	Production	13	294	—	—	4,488	+547	
	Production and sale	9	756	161	—	24,300	+478	
	TOTAL	61	2,802	73,504	59,992	3,55,214	18,817	

Assam	Production	1	208	..	..	3,114	—190
	Production and sale	24	471	19,984	17,498	21,943	+450
	TOTAL	25	679	19,984	17,498	25,057	+260
North-West Frontier Province.	Production and sale	17	5,501	2,327	1,582	1,258	44
Delhi	Production and sale	10	721	..	..	233	122
Mysore	Purchase and purchase and sale.	27	745	4,751	..	74,021	+301
	Production and sale	20	476	1,092	118	18,694	+167
	Others	43	1,266	..	..	18,268	+283
	TOTAL	90	2,487	5,843	118	1,10,983	+751
Baroda	Purchase and purchase and sale.	11	421	515	..	3,049	30
	Production	26	1,147	3,803	143	1,28,039	155
	Production and sale	20	1,232	2,55,082	2,30,505	93,073	2,384
	Others	96	5,190	612	..	4,303	1,982
	TOTAL	153	7,990	2,70,012	2,30,648	2,28,464	4,241
Hyderabad	Purchase and purchase and sale.	12	1,243	87,559	2,23,107	89,404	+9,721
Travancore	Production and sale	1	49	316	..	234	—26

Operations of Non-credit Agricultural Co-operative Societies in India during 1933-34 and 1934-35—concld.

(B) CATTLE INSURANCE.

Province	Number of Societies	Amount of risk insured	Premia collected during the year	Supplementary contributions collected	NUMBER OF ANIMALS		Claims paid	Cost of management	Funds in hand at the end of the year	Amount of risk re-insured	Amount of premia paid for re-insurance
					Insured	Lost					
		Rs.	Rs.	Rs.			Rs.	Rs.	Rs.	Rs.	Rs.
					1933-34						
Bombay . .	2	17,785	892	..	266	18	633	499	1,764	..	..
Burma . .	239	3,600	66	71	136	2	57	47	17,694	1,359	33
					1934-35						
Bombay . .	1	8,870	444	—	150	12	493	456	912	1,195	60
Burma . .	239	3,780	90	..	118	5	121	27	17,342	1,890	44

APPENDIX X.

List of Agricultural Publications in India published during 1933-35.

No.	Title	Author	Where published
	GENERAL AGRICULTURE		
1	*Agriculture and Livestock in India*, Vol. III, Parts IV, V and VI; Vol. IV, Parts I to VI; Vol. V, Parts I to III. Annual subscription, Rs. 6 or 9*s*. 9*d*. (A bi-monthly Journal of Agriculture and Animal Husbandry for the general reader interested in agriculture or livestock in India or the Tropics).	Issued under the authority of the Imperial Council of Agricultural Research.	Manager of Publications, Delhi.
2	*The Madras Agricultural Journal* (Monthly). Annual subscription, Rs. 4.	K. Ramiah (Editor). Published by the M. A. S. Union, Agricultural and Research Institute, Coimbatore.	The Secretary, M. A. S. Union, Agricultural College, Lawley Road P. O.
3	*The Journal of the Trichinopoly District Agricultural Association* (English and Tamil). (Quarterly). Annual subscription, Re. 1-8-0 for non-members, free for members.	Issued by the Trichinopoly District Agricultural Association, Teppakulam Post.	The Secretary, the Trichinopoly District Agricultural Association, Teppakulam Post.
4	*Poona Agricultural College Magazine* (Quarterly). Annual subscription, Rs. 2-8-0.	V. G. Deshpande and S. M. Rao (Editors).	The Editor, Poona Agricultural College Magazine, Poona.
5	*Shetki Shetkhari* (Marathi, Monthly). Annual subscription, Re. 1-3-0.	Vasudev Ganesh Pande .	The Editor, " Shekti Shetkhari ", Agricultural College, Poona.
6	*Krishi Sampad* (Bengali, Monthly). Annual subscription, Rs. 3.	N. K. Ghosh (Editor) .	Manager, Krishi Sampada Press, Dacca.
7	*The Planters' Journal and Agriculturist* (Fortnightly). Annual subscription, Rs. 10 or 16*s*.	Theo. H. Thorne (Editor)	The Manager, the Planters' Journal and Agriculturist, 13, Ezra Mansion, Calcutta.
8	*Mufidul Mazarain* (Urdu) .	Issued by the Department of Agriculture, United Provinces.	Government Printing and Stationery, United Provinces, Allahabad.
9	*Kisan Upkarak* (Hindi) . .	Ditto . .	Ditto.

List of Agricultural Publications in India published during 1933-35—contd.

No.	Title	Author	Where published
	GENERAL AGRICULTURE—*contd.*		
10	*The Allahabad Farmer* (Quarterly). Annual subscription in India, Rs. 2.	B. M. Pugh (Editor). Published by the Agricultural Institute, Allahabad.	The Allahabad Agricultural Institute, United Provinces American Presbyterian Mission, Allahabad.
11	*Seasonal Notes.* Price, As. 4 per copy.	Issued by the Department of Agriculture, Punjab.	Government Printing, Punjab, Lahore.
12	*Kisan* (Hindi). Annual subscription, Rs. 2. Price, As. 8 per copy.	Issued by the Agricultural Association, Bihar and Orissa.	B. N. Sarcar, Senior Marketing Officer and Editor, " Kisan ", Patna.
13	*The Nagpur Agricultural College Magazine* (Quarterly). Annual subscription, Rs. 3.	Published by P. D. Nair, Agricultural College, Nagpur.	The Editor, " The Nagpur Agricultural College Magazine ", Nagpur.
14	*The Journal of the Mysore Agricultural and Experimental Union.* (English. Quarterly.) Price, As. 12 per copy.	B. Narasimha Iyengar (Chief Editor).	The Secretary, The Mysore Agricultural and Experimental Union, Seshadri Road, Bangalore.
15	*The Journal of the Mysore Agricultural and Experimental Union.* (Kannada. Monthly.) Price, As. 4 per copy.	N. Venkatasubbaiya	Ditto.
16	Annual Report of the Imperial Council of Agricultural Research for the year 1933-34.	Issued by the Imperial Council of Agricultural Research.	Manager of Publications, Delhi.
17	Annual Report of the Imperial Council of Agricultural Research for the year 1934-35.	Ditto	Ditto.
18	Review of Agricultural Operations in India, 1931-33. Price Rs. 5-12 or 9*s.* 6*d.*	Ditto	Ditto.
19	Mechanical Cultivation in India :—A history of the large scale experiments carried out by Burmah-Shell Oil Storage and Distributing Company of India, Ltd. Scientific Monograph, No. 9 of the Imperial Council of Agricultural Research. Price, Rs. 3-14-0 or 6*s.* 6*d.*	C. P. G. Wade	Ditto.
20	Report on Coconut Enquiry in India. Issued by the Imperial Council of Agricultural Research. Price, Rs. 3-8-0 or 6*s.*	J. S. Patel	Ditto.

List of Agricultural Publications in India published during 1933-35—contd.

No.	Title	Author	Where published
	GENERAL AGRICULTURE—*contd.*		
21	The Production of Cigarette Tobacco by Flue-curing (Pusa Bulletin No. 187, revised 1935). Price, Re. 1 or 1*s*. 9*d*.	F. J. F. Shaw and Kashi Ram.	Manager of Publications, Delhi.
22	Scientific Reports of the Imperial Institute of Agricultural Research, Pusa (including the Reports of the Imperial Dairy Expert, Physiological Chemist and Sugarcane Expert) for 1933-34. Price, Rs. 4-12-0 or 8*s*.	Director, Imperial Institute of Agricultural Research, Civil Lines, Delhi.	Ditto.
23	Report on the Operations of the Department of Agriculture, Madras Presidency, for the year 1932-33.	Issued by the Department of Agriculture, Madras.	Government Press, Madras.
24	Report on the Operations of the Department of Agriculture, Madras Presidency, for the year 1933-34.	Ditto . .	Ditto.
25	Reports of Subordinate Officers of the Department of Agriculture, Madras, for 1932-33. Price, Rs. 4-2-0.	Ditto . .	Ditto.
26	Reports of Subordinate Officers of the Department of Agriculture, Madras, for 1933-34.	Ditto . .	Ditto.
27	Villagers' Calendar for 1934-35, and 1935-36 (Tamil, Telugu, Kanarese and Malayalam).	Ditto . .	Ditto.
28	Villagers' Calendar for 1934 and 1935 (English).	Ditto . .	Ditto.
29	The Improvement of Quality of South Indian Groundnut (English, Tamil, Telugu, Malayalam and Kanarese). Leaflet No. 50 of the Department of Agriculture, Madras.	J. S. Patel . . .	Ditto.
30	Selection work in Coconuts (English, Tamil, Telugu, Kanarese and Malayalam). Leaflet No. 52 of the Department of Agriculture, Madras.	Ditto . .	Ditto.

List of Agricultural Publications in India published during 1933-35—contd.

No.	Title	Author	Where published
	GENERAL AGRICULTURE—*contd.*		
31	The Improvement of Coconut under dry cultivation (English, Kanarese and Malayalam). Leaflet No. 59 of the Department of Agriculture, Madras.	K. W. Chakrapani Marar	Government Press, Madras.
32	Kanarese Proverbs on Agriculture (Kanarese with English translation). Bulletin No. 35 of the Department of Agriculture, Madras.	Issued by the Department of Agriculture, Madras.	Ditto.
33	A bund forming implement (Tamil, Kanarese and Malayalam). Leaflet No. 61 of the Department of Agriculture, Madras.	N. G. Charley . .	Ditto.
34	Coriander—How to improve its quality for marketing (English, Tamil, Telugu, Kanarese and Malayalam). Leaflet No. 62 of the Department of Agriculture, Madras.	P. V. Ramiah . .	Ditto.
35	A simple and cheap process for the Conservation of Farmyard Manure (Telugu). Notes of the Department of Agriculture, Madras.	T. Budhavidheya Rao .	Ditto.
36	Malayalam Sayings and Proverbs on Agriculture (Malayalam). Bulletin of the Department of Agriculture, Madras.	K. T. Alwa and K. Unnikrishna Menon.	Ditto.
37	Picking and marketing of Cambodia cotton in Salem District (English and Tamil). Leaflet No. 62 of the Department of Agriculture, Madras.	K. Raghavachari . .	Ditto.
38	Reports on the work of the Agricultural Stations in the Madras Presidency for the year 1933-34.	Issued by the Department of Agriculture, Madras.	Ditto.
39	Electricity in Agriculture .	Issued by the Madras Government, Electricity Department.	Ditto.
40	Electric Power for Agricultural Uses.	Ditto .	Ditto.

List of Agricultural Publications in India published during 1933-35—contd.

No.	Title	Author	Where published
	GENERAL AGRICULTURE—*contd.*		
41	Cotton Leaflet No. 66 of the Department of Agriculture, Madras (English, Tamil and Kanarese).	A. C. Edmonds . .	Government Press, Madras.
42	How to send specimens for examination. (Reprinted). Leaflet No. 21 of the Department of Agriculture, Madras.	S. R. Srinivasa Iyengar .	Ditto.
43	The Economic Condition of the Ryot in the Vizagapatam District and how to improve it. Bulletin No. 46 of the Depart- of Agriculture, Madras. Price, As. 6.	Jogi Raju . . .	Ditto.
44	Some practical hints on Bee-keeping. Bulletin No. 37 of the Department of Agriculture, Madras. Price, Re. 1.	S. Ramchandra Iyer .	Ditto.
45	*Tokra* (*Orobanche* sp.). A pest on tobacco.	T. Budhavidheya Rao Naidu.	Ditto.
46	Annual Report of the Department of Agriculture in the Bombay Presidency for the year 1932-33.	Issued by the Department of Agriculture, Bombay Presidency.	Government Central Press, Bombay.
47	Annual Report of the Department of Agriculture in the Bombay Presidency for the year 1933-34.	Ditto . .	Ditto.
48	Annual Report of the Department of Agriculture in Sind for the year 1932-33.	Issued by the Chief Agricultural Officer, Sind.	Ditto.
49	Annual Report of the Department of Agriculture in Sind for the year 1933-34.	Ditto . .	Ditto.
50	Annual Report of the Department of Agriculture, Bengal, for the year 1932-33, Part I. Price, As. 9 or 1*s*.	Issued by the Department of Agriculture, Bengal.	Bengal Secretariat Book Depôt, Calcutta.
51	Annual Report of the Department of Agriculture, Bengal, for the year 1933-34, Part I.	Ditto . .	Ditto.
52	Annual Report of the Department of Agriculture, Bengal, for the year 1932-33, Part II. Record of Experimental Work. Price, Re. 1-3-0 or 2*s*.	Ditto . .	Ditto.

List of Agricultural Publications in India published during 1933-35—contd.

No.	Title	Author	Where published
	GENERAL AGRICULTURE—*contd.*		
53	Annual Report of the Department of Agriculture, Bengal, for the year 1933-34, Part II. Record of Experimental Work.	Issued by the Department of Agriculture, Bengal.	Bengal Secretariat Book Depôt, Calcutta.
54	Destruction of Water-hyacinth. Bengal Department of Agriculture, Leaflet No. 3 of 1933.	Ditto . .	Ditto.
55	The Cultivation of Groundnut (English and Bengali). Bengal Department of Agriculture, Leaflet.	Ditto . .	Ditto.
56	Jute Cultivation in Bengal. Bengal Department of Agriculture, Leaflet (English and Bengali).	Ditto . .	Ditto.
57	Note on Cotton Cultivation (revised). Bulletin No. 2 of 1932 of the Department of Agriculture, Bengal.	Ditto . .	Bengal Government Press Alipore, Bengal.
58	Report on the Administration of the Department of Agriculture, United Provinces, for the year ending June 30, 1933.	Issued by the Department of Agriculture, United Provinces.	Government Printing and Stationery, United Provinces, Allahabad.
59	Report of the Administration of the Department of Agriculture, United Provinces, for the year ending June 30, 1934.	Ditto . .	Ditto.
60	Report on the comparative trials of Hadi and Rohilkhand *Bels*. United Provinces Department of Agriculture Bulletin No. 62.	R. L. Sethi . . .	Ditto.
61	Better Farming, a note on village demonstration and technical procedure in the building up of better village practice. United Provinces Department of Agriculture Bulletin No. 67.	R. G. Allan . . .	Ditto.
62	Potato cultivation (Urdu and Hindi). Leaflet of the United Provinces Department of Agriculture.	P. K. Dey . . .	Ditto.

List of Agricultural Publications in India published during 1933-35—contd.

No.	Title	Author	Where published
	GENERAL AGRICULTURE—*contd.*		
63	Sann-hemp Cultivation in the United Provinces, its importance in Indian Industries and Trade (English, Urdu and Hindi).	T. S. Sabnis . . .	Government Printing and Stationery, United Provinces, Allahabad.
64	Linseed cultivation in the United Provinces, its importance in Indian Industries and Trade (English, Urdu and Hindi).	Ditto . . .	Ditto.
65	Instructions for sowing improved varieties of Rice Seeds (English, Urdu and Hindi).	R. L. Sethi . . .	Ditto.
66	The Olpad Thresher (Urdu and Hindi). United Provinces Department of Agriculture Leaflet No. 1 of 1934.	R. G. Allan . . .	Ditto.
67	Use of Cattle urine as manure (Urdu and Hindi).	S. B. Singh . . .	Ditto.
68	Cultivation of Groundnut. United Provinces Department of Agriculture Leaflet.	T. S. Sabnis . . .	Ditto.
69	*Tariqa Kasht Jarham Dhan* (Urdu and Hindi). Leaflet No. 8 of the Department of Agriculture, United Provinces.	Issued by the Department of Agriculture, United Provinces.	Ditto.
70	*Mausam-i-garma ki Jotai, Gehun aur Rabi ki dusri faslon ke waste* (Urdu and Hindi). Leaflet No. 9 of the Department of Agriculture, United Provinces.	Ditto . .	Ditto.
71	Agricultural Implements, Part I (English and Urdu). Leaflet No. 10 of the Department of Agriculture, United Provinces.	Ditto . .	Ditto.
72	Agricultural Implements, Part II (English). Leaflet No. 11 of the Department of Agriculture, United Provinces.	Ditto .	Ditto.
73	Manures (English and Hindi). Leaflet No. 12 of the Department of Agriculture, United Provinces.	Ditto . .	Ditto.

List of Agricultural Publications in India published during 1933-35—contd.

No.	Title	Author	Where published
	GENERAL AGRICULTURE—*contd.*		
74	*Rabi ki fasl ki katai ki babat chand baten* (Hindi). Leaflet No. 16 of the Department of Agriculture, United Provinces.	Issued by the Department of Agriculture, United Provinces.	Government Printing and Stationery, United Provinces, Allahabad.
75	*Tariqa Kasht Kapas* No. 520. Leaflet No. 17 of the Department of Agriculture, United Provinces.	Ditto . .	Ditto.
76	A summary of the Important results arrived at or indicated by the Agricultural Stations in the United Provinces during the year 1933-34.	Ditto . .	Ditto.
77	Methods of Improvement in Crops. Bulletin No. 1, General Series of the Department of Agriculture, United Provinces.	R. L. Sethi, B. L. Sethi and T. R. Mehta.	Ditto.
78	Early Sowing of Sugarcane (Urdu). Leaflet No. 6 of the Department of Agriculture, United Provinces.	Issued by the Department of Agriculture, United Provinces.	Ditto.
79	Utilization of Water-hyacinth as Manure. Leaflet No. 24 of the Department of Agriculture, United Provinces.	Ditto . .	Ditto.
80	Field rats in the United Provinces (Hindi). Leaflet No. 6 of the Department of Agriculture, United Provinces.	Ditto . .	Ditto
81	Annual Report of the Department of Agriculture, Punjab, for the year ending 30th June 1933. Price Re. 1-4-0.	Issued by the Department of Agriculture, Punjab.	Government Printing, Punjab, Lahore.
82	Annual Report of the Department of Agriculture, Punjab, for the year ending 30th June 1934.	Ditto . .	Ditto
83	Elephant Grass. Leaflet No. 108 of the Department of Agriculture, Punjab.	Ditto . .	Ditto
84	Eradication of *Pohli*, etc. Leaflet No. 111 of the Department of Agriculture, Punjab.	Ditto . .	Ditto

List of Agricultural Publications in India published during 1933-35—contd.

No.	Title	Authority	Where published
	GENERAL AGRICULTURE—*contd.*		
85	C. 591. A new high quality wheat. Leaflet No. 118 of the Department of Agriculture, Punjab.	Issued by the Department of Agriculture, Punjab.	Government Printing, Punjab, Lahore.
86	Sun-heat treatment of cotton seed as a prevention against pink bollworm. Leaflet No. 122 of the Department of Agriculture, Punjab.	Ditto . .	Ditto.
87	Prospectus of the Punjab Agricultural College, Lyallpur.	Ditto . .	Ditto.
88	Instructions to Silk Worm Rearer. Leaflet No. 125 of the Department of Agriculture, Punjab.	Ditto . .	Ditto.
89	A new early-maturing Strain of Punjab-American 43-F. Leaflet No. 126 of the Department of Agriculture, Punjab.	Ditto . .	Ditto.
90	Report on the Operations of the Department of Agriculture, Burma, for the year ended the 31st March 1933. Price, Rs. 1-8-0 or 2*s*. 3*d*.	Issued by the Department of Agriculture, Burma.	Government Printing, Burma, Rangoon.
91	Report on the Operations of the Department of Agriculture, Burma, for the year ended the 31st March 1934.	Ditto . .	Ditto.
92	Burma Cotton and its Improvement. Agricultural Survey No. 18 of 1933.	Ditto . .	Ditto.
93	Annual Report of the Department of Agriculture, Bihar and Orissa, 1932-33.	Issued by the Department of Agriculture, Bihar and Orissa.	Government Printing, Bihar and Orissa, Patna.
94	Annual Report of the Department of Agriculture, Bihar and Orissa, 1933-34.	Ditto . .	Ditto.
95	Annual Report on Experimental Farms in Bihar and Orissa, 1932-33.	Ditto . .	Ditto.
96	Annual Report on Experimental Farms in Bihar and Orissa, 1933-34.	Ditto . .	Ditto.

List of Agricultural Publications in India published during 1933-35—contd.

No.	Title	Authority	Where published
	GENERAL AGRICULTURE—*contd.*		
97	Research and Agriculture. Bihar and Orissa Department of Agriculture Bulletin No. 6 of 1933.	D. R. Sethi . . .	Government Printing, Bihar and Orissa, Patna.
98	Hints on dealing with sand deposited on land as a result of the Earthquake. Bihar and Orissa Department of Agriculture Bulletin No. 2 of 1934.	Issued by the Department of Agriculture, Bihar and Orissa.	Government Press, Bihai and Orissa, Gulzarbagh.
99	Sand Clearing. Bihar and Orissa Department of Agriculture Leaflet No. 2 of 1934.	Ditto . .	Ditto.
100	A Note on Agricultural Calendar for Orissa and some systems of multiple cropping under Orissa conditions.	Ditto . .	Ditto.
101	Report on the working of the Department of Agriculture of the Central Provinces for the year ending 31st March 1933.	Issued by the Department of Agriculture, Central Provinces.	Government Printing, Central Provinces, Nagpur.
102	Report on the working of the Department of Agriculture of the Central Provinces for the year ending the 31st March 1934.	Ditto . .	Ditto.
103	Report on the Agricultural College, Nagpur and Agricultural Engineer's Section, Agricultural College, Nagpur, for the year ending the 31st March 1933.	Ditto . .	Ditto.
104	Report on the Agricultural College, Nagpur and Agricultural Engineer's Section, Agricultural College, Nagpur, for the year ending the 31st March 1934.	Ditto . .	Ditto.
105	Annual Report on Experimental Farms, Nagpur, Akola, Powarkhera, Adhartal, Chhindwara, Tharsa and Raipur, for the year ending the 31st March 1933.	Ditto . .	Ditto.

List of Agricultural Publications in India published during 1933-35—contd.

No.	Title	Authority	Where published
	GENERAL AGRICULTURE—*contd.*		
106	Annual Report on Experimental Farms, Nagpur, Akola, Powarkhera, Adhartal, Chhindwara, Tharsa and Raipur, for the year ending the 31st March 1934.	Issued by the Department of Agriculture, Central Provinces.	Government Printing, Central Provinces, Nagpur.
107	Report on Demonstration work carried out in the Southern Circle, Central Provinces, together with Reports on the Seed and Demonstration and Cattle-breeding Farms of the Circle for the year ending the 31st March 1933.	Ditto . .	Ditto.
108	Report on Demonstration work carried out in the Southern Circle, Central Provinces, together with Reports on the Seed and Demonstration and Cattle-breeding Farms of the Circle for the year ending the 31st March 1934.	Ditto . .	Ditto.
109	Report on Demonstration work carried out in the Northern Circle, Central Provinces, together with Reports on the Seed and Demonstration and Cattle-breeding Farms of the Circle for the year ending the 31st March 1933.	Ditto . .	Ditto.
110	Report on Demonstration work carried out in the Northern Circle, Central Provinces, together with Reports on the Seed and Demonstration and Cattle-breeding Farms of the Circle for the year ending the 31st March 1934.	Ditto .	Ditto.
111	Report on Demonstration work carried out in the Western Circle, Central Provinces, together with Reports on the Seed and Demonstration and Cattle-breeding Farms of the Circle for the year ending the 31st March 1933.	Ditto . .	Ditto.

List of Agricultural Publications in India published during 1933-35—contd.

No.	Title	Authority	Where published
	GENERAL AGRICULTURE—*contd.*		
112	Report on Demonstration work carried out in the Western Circle, Central Provinces, together with Reports on the Seed and Demonstration and Cattle-breeding Farms of the Circle for the year ending the 31st March 1934.	Issued by the Department of Agriculture, Central Provinces.	Government Printing, Central Provinces, Nagpur.
113	Reports on Demonstration work carried out in the Eastern Circle, Central Provinces, together with Reports on the Seed and Demonstration and Cattle-breeding Farms of the Circle for the year ending the 31st March 1933.	Ditto . .	Ditto.
114	Reports on Demonstration work carried out in the Eastern Circle, Central Provinces, together with Reports on the Seed and Demonstration and Cattle-breeding Farms of the Circle for the year ending the 31st March 1934.	Ditto . .	Ditto.
115	A Scheme for the extension of long staple cotton in the Central Provinces and Berar (Hindi and Marathi). Leaflet of the Department of Agriculture, Central Provinces.	Ditto . .	Ditto.
116	Why India should grow more Linseed (English, Hindi, and Marathi). Central Provinces Department of Agriculture Leaflet.	Ditto . .	Ditto.
117	Groundnut as a Rotation Crop with Cotton (Marathi). Central Provinces Department of Agriculture Leaflet.	Ditto . .	Ditto.
118	Oil-seeds in the Central Provinces and Berar (English, Hindi, and Marathi). Central Provinces Department of Agriculture Bulletin No. 27. Price, As. 2 each.	Ditto . .	Ditto.

List of Agricultural Publications in India published during 1933-35—contd.

No.	Title	Authority	Where published
	GENERAL AGRICULTURE—*contd.*		
119	Catalogue of the varieties of the main crops of the Central Provinces and Berar recommended by the Agricultural Department. Price, As. 4.	Issued by the Department of Agriculture, Central Provinces.	Government Printing Central Provinces, Nagpur.
120	Rich Manure. The Gold of Farmers, Nos. 1 and 2 (Revised). (English, Hindi and Marathi).	Ditto . .	Ditto.
121	A short note on field rats and how to control them (Revised) (English, Hindi and Marathi).	Ditto . .	Ditto.
122	A leaflet on Message to Agriculturist regarding line-sowing (Hindi).	Ditto . .	Ditto.
123	Annual Report of the Department of Agriculture, Assam, for the year 1932-33.	Issued by the Department of Agriculture, Assam.	Government Printing, Assam, Shillong.
124	Annual Report of the Department of Agriculture, Assam, for the year 1933-34.	Ditto . .	Ditto
125	Some Common Wild Grasses, Sedges and Pasture Land legumes of Assam. Assam Department of Agriculture Bulletin No. 2 of 1933.	Ditto . .	Ditto.
126	Cultivation of substitute Crop for Jute (Bengali and Assamese). Bulletin No. 6 of 1935 of the Department of Agriculture, Assam.	Ditto . .	Ditto.
127	Annual Report on the Department of Agriculture, North-West Frontier Province, for the year ending 30th June 1933.	Issued by the Government of North-West Frontier Province, Peshawar.	Manager, Government Stationery & Printing, North-West Frontier Province, Peshawar.
128	Annual Report on the Department of Agriculture, North-West Frontier Province, for the year ending 30th June 1934.	Ditto . .	Ditto.
129	Annual Administration Report of the Department of Agriculture, Mysore State, for 1933-34. Price, Rs. 1-8-0.	Issued by the Department of Agriculture, Mysore.	Government Press, Bangalore.

List of Agricultural Publications in India published during 1933-35—contd.

No.	Title	Authority	Where published
	GENERAL AGRICULTURE—*contd.*		
130	Annual Report of the Coffee Scientific Officer, 1933-34. Mysore Coffee Experimental Station Bulletin No. 12.	W. W. Mayne . .	Government Press, Bangalore.
131	Annual Report of the Coffee Scientific Officer, 1934-35. Price, As. 4.	Ditto . . .	Ditto.
132	Report on the Administration of the Department of Agriculture and Fisheries, Travancore State, for the year 1933-34.	Issued by the Director of Agriculture and Fisheries, Travancore.	Government Press, Travancore.
133	T. E. B. No. 1, Paddy Seeds evolved by the Botanist for the Alkaline Lands in South Travancore.	N. K. B. Kurup . .	Ditto.
134	*Typha* Spp. (Tamil-Champa). A Note in English.	Ditto . . .	Ditto.
135	Manuring of Coconut Palms .	N. K. Narayana Pillai .	Ditto.
136	P. C. Digger, a small hand tool useful for weeding and interculture in kitchen gardens.	Issued by the Agricultural Department, Travancore.	Superintendent Government Press, Trivandrum.
137	Report on the Administration of the Agricultural Department, Cochin State, for the year 1932-33.	Issued by the Superintendent of Agriculture, Trichur.	Cochin Government Press, Ernakulam.
138	Report on the Administration of the Agricultural Department, Cochin State, for the year 1933-34.	Ditto . .	Ditto.
139	Marketing Survey. (Malayalam).	Ditto . .	Ditto.
140	Seeds and Seed Selection (Malayalam).	Ditto . .	Ditto.
141	Selection of Paddy Seeds (Malayalam). Leaflet of the Department of Agriculture, Cochin.	Ditto . .	Ditto.
142	Annual Report of the Department of Agriculture, Gwalior Government, for the year 1932-33.	Issued by the Department of Agriculture, Gwalior Government.	Alijah Durbar Press, Gwalior.

List of Agricultural Publications in India published during 1933-35—contd.

No.	Title	Authority	Where published
	GENERAL AGRICULTURE—*contd.*		
143	A Summary of the Present Activities of the Department of Agriculture, Gwalior Government Bulletin No. 15.	Issued by the Department of Agriculture, Gwalior Government.	Alijah Durbar Press, Gwalior.
144	Instructions on destruction of rats in the fields (vernacular). Issued gratis.	P. Jia Lal Raina . .	Agricultural Department, Jammu and Kashmir, Srinagar.
145	Annual Report of the Indian Central Cotton Committee for the year ending 31st August 1934. Price, Rs: 2.	Issued by the Indian Central Cotton Committee, Bombay.	Indian Central Cotton Committee, Bombay.
146	Bombay Cotton Annual No. 14. Price, Rs. 2.	Issued under the authority of the East India Cotton Association, Ltd., Bombay.	Published by the Manager, Clearing House, East India Cotton Association, Bombay.
147	Summary Proceedings of the Twenty-ninth meeting of the Indian Central Cotton Committee, Bombay, held on the 28th and 29th August 1934. Price, Re. 1.	Issued by the Indian Central Cotton Committee, Bombay.	Indian Central Cotton Committee, Bombay.
148	Summary Proceedings of the Thirtieth meeting of the Indian Central Cotton Committee, Bombay, held on the 4th and 5th February 1935. Price, Re. 1.	Ditto . .	Ditto.
149	Cotton cultivation on the Indus right bank areas (Pamphlet issued gratis).	Issued by the Publicity Officer, Indian Central Cotton Committee.	Ditto.
150	Notes on the Improvement of Cotton in Sind (Pamphlet issued gratis).	Ditto . .	Ditto.
151	Hyderabad Botanical Scheme (Urdu, Marathi and Kanarese). Leaflet issued gratis.	Ditto . .	Ditto.
152	Institute of Plant Industry (Hindi and Marathi). Leaflet issued gratis.	Ditto . .	Ditto.
153	Verum Cotton (Hindi). Leaflet issued gratis.	Ditto . .	Ditto.

List of Agricultural Publications in India published during 1933-35—contd.

No.	Title	Authority	Where published
	GENERAL AGRICULTURE—*concld.*		
154	Get more money for your Cotton crop by removing roots with a Plant Puller and thus exterminate the Boll-worms. (Gujarati). Reprint issued gratis.	Issued by the Publicity Officer, Indian Central Cotton Committee.	Indian Central Cotto Committee, Bombay.
155	On the use of Plant Puller (Gujrati) (Reprint). Hand-bill issued gratis.	Ditto . .	Ditto.
156	Progress Report of the Institute of Plant Industry, Indore, for the year ending 30th June 1934.	Issued by the Director, Institute of Plant Industry, Indore.	Institute of Plant Industry, Indore.
157	Cotton Cultivation in Gang Canal Colony (Urdu). Leaflet No. 9 of the Institute of Plant Industry, Indore.	Ditto . .	Ditto.
	AGRICULTURAL ECONOMICS.		
158	Marketing of some Agricultural Products exported from Bombay to the United Kingdom. Bombay Department of Agriculture Bulletin No. 173 of 1933. Price, Annas 3.	T. G. Shirname . .	Government Centra Press, Bombay.
159	Sann-hemp Marketing Advantages. (Urdu and Hindi). Leaflet of the United Provinces Department of Agriculture.	T. S. Sabnis . . .	Government Printin and Stationery, Unite Provinces, Allahabad.
160	Report on the Fifth Regular Wages Survey of the Punjab held in December 1932. Price, Re. 1-2-0.	Issued by the Department of Agriculture, Punjab.	Government Printing, Punjab, Lahore.
161	Family Budgets, 1932-33 of Four Tenant-cultivators in the Lyallpur District. The Board of Economic Enquiry, Punjab Publication No. 40. Price, Annas 6.	Sardar Kartar Singh .	Published by Civi and Military Gazette Ltd., Lahore.
162	An Economic Survey of Gajja Chak, a village in the Gujranwala District of the Punjab. Board of Economic Enquiry, Punjab. Rural Section Publication No. 31. Price, Rs. 3.	Inquiry conducted by Anchal Dass, under the supervision of C. E. Strickland.	Ditto.

List of Agricultural Publications in India published during 1933-35—contd.

No.	Title	Author	Where published
	AGRICULTURAL STATISTICS.		
163	Estimates of Area and Yield of Principal Crops in India, 1933-34. Price, Re. 1-2-0 or 2*s*.	Issued by the Department of Commercial Intelligence and Statistics, India, Calcutta.	Manager of Publications, Delhi.
164	Agricultural Statistics of India 1931-32, Volume II.	Ditto . . .	Ditto.
165	Quinquennial Reports on the Average Yield per acre of Principal Crops in India for the period ending 1931-32. Price, Re. 1-14 or 3*s*. 3*d*.	Ditto . . .	Ditto.
166	Indian Tea Statistics, 1933. Price, As. 8 or 10*d*.	Ditto . . .	Ditto.
167	Indian Rubber Statistics, 1933. Price, As. 4 or 5*d*.	Ditto . . .	Ditto.
168	Indian Coffee Statistics, 1933-34. Price, As. 6 or 8*d*.	Ditto . . .	Ditto.
169	Season and Crop Report of the Madras Presidency, 1933-34.	Issued by the Board of Revenue, Land Revenue and Settlement, Madras.	Government Press, Madras.
170	Annual Season and Crop Report of the Bombay Presidency for the year 1932-33. Price, As. 7.	Issued by the Department of Agriculture, Bombay.	Government Central Press, Bombay.
171	Annual Season and Crop Report of the Bombay Presidency for the year 1933-34. Price, As. 7.	Ditto . . .	Ditto.
172	Season and Crop Report of Bengal for 1932-33. Price, As. 6.	Issued by the Department of Agriculture, Bengal.	Bengal Secretariat Book Depôt, Calcutta.
173	Season and Crop Report of Bengal for 1933-34. Price, As. 8.	Ditto . . .	Ditto.
174	Monthly and Annual Rainfall Tables in the Province of Bengal for 1933.	Ditto . . .	Ditto.
175	Monthly and Annual Rainfall Tables in the Province of Bengal for 1934.	Ditto . . .	Ditto.
176	Season and Crop Report of United Provinces of Agra and Oudh for the year 1932-33. Price, Re. 1-4-0.	Issued by the Department of Land Records, United Provinces.	Government Printing and Stationery, United Provinces, Allahabad.

List of Agricultural Publications in India published during 1933-35—contd.

No.	Title	Author	Where published
	AGRICULTURAL STATISTICS—*concld.*		
177	Season and Crop Report of United Provinces of Agra and Oudh for the year 1933-34. Price, Re. 1-4-0.	Issued by the Department of Land Records, United Provinces.	Government Printing and Stationery, United Provinces, Allahabad.
178	Season and Crop Report of the Punjab for the Agricultural year ending 30th June 1933. Price, Rs. 3-8-0 or 5*s.* 3*d.*	Issued by the Department of Agriculture, Punjab.	Government Printing, Punjab, Lahore.
179	Season and Crop Report of the Punjab for the Agricultural year ending 30th June 1934. Price, Rs. 3-4-0.	Ditto . . .	Ditto.
180	Season and Crop Report of Burma for the year ending the 30th June 1933. Price, Rs. 2 or 3*s.*	Issued by the Commissioner of Settlements and Land Records, Burma.	Government Printing and Stationery, Burma, Rangoon.
181	Season and Crop Report of Burma for the year ending 30th June 1934. Price, Rs. 2 or 3*s.*	Ditto . . .	Ditto.
182	Season and Crop Report of Bihar and Orissa for the year 1932-33. Price, Rs. 2-4-0.	Issued by the Department of Agriculture, Bihar and Orissa, Patna.	Government Press, Bihar and Orissa, Gulzarbagh.
183	Season and Crop Report of Bihar and Orissa for the year 1933-34. Price, Rs. 2-4-0.	Ditto .	Ditto.
184	Agricultural Statistics, Bihar and Orissa, 1932-33.	Ditto .	Ditto.
185	Agricultural Statistics, Bihar and Orissa, 1933-34.	Ditto .	Ditto.
186	Season and Crop Report of the Central Provinces and Berar for the year ending the 31st May 1934. Price, Re. 1-8-0.	Issued by the Director of Land Records, Central Provinces and Berar.	Government Printing, Central Provinces, Nagpur.
187	Report on the Season and Crops of the North-West Frontier Province for the year 1932-33. Price, Rs. 2-4-0 or 3*s.* 9*d.*	Issued by the Revenue and Divisional Commissioner, North-West Frontier Province.	Manager, Government Stationery and Printing, North-West Frontier Province, Peshawar.

List of Agricultural Publications in India published during 1933-35—contd.

No.	Title	Author	Where published
	SUGAR RESEARCH.		
188	The Open Pan System of White Sugar Manufacture (2nd edition, 1935). Scientific Monograph No. 3 of the Imperial Council of Agricultural Research. Price, Rs. 3-2-0 or 5*s*. 6*d*.	R. C. Srivastava . .	Manager of Publications, Delhi.
189	Some Practical Suggestions to Cane-Growers. Madras Department of Agriculture, Pamphlet No. 7.	S. Sitharam Patrudu .	Government Press, Madras.
190	The Manufacture of White Sugar by Open Pan System (English, Tamil, Telugu, Kanarese and Malayalam). Madras Department of Agriculture, Leaflet No. 51.	Ditto .	Ditto
191	Some Practical Suggestions to Cane-growers (Telugu).	Ditto .	Ditto.
192	The Planting of Sugarcane. Bulletin No. 38 of the Department of Agriculture, Madras. Price, As. 4.	A. C. Edmonds . .	Ditto.
193	Manufacture of white sugar and *gur* by the open pan process. Bulletin No. 175 of 1934 of the Department of Agriculture, Bombay. Price, As. 3.	V. V. Gadgil . .	Government Central Press, Bombay.
194	A note on the Improved Open Single Pan Furnace (Hindi). United Provinces Department of Agriculture, Bulletin No. 65.	B. Harbhajan Lal . .	Government Printing and Stationery, United Provinces, Allahabad.
195	Single Pan Furnace (Urdu and Hindi).	Ditto .	Ditto.
196	Results of Sugarcane Experiments at the Government Agricultural Farm, Shahjahanpur (Urdu and Hindi).	R. L. Sethi . . .	Ditto.
197	Good *Gur* and Method of its manufacture (Urdu). Leaflet No. 20 of the Department of Agriculture, United Provinces.	Issued by the Department of Agriculture, United Provinces.	Ditto.
198	*Ikh ki bowai jaldi karao pechhar jane se nuqsan hai* (Urdu and Hindi). Leaflet No. 6 of the Department of Agriculture, United Provinces.	Ditto .	Ditto.

List of Agricultural Publications in India published during 1933-35—contd.

No.	Title	Author	Where published
	SUGAR RESEARCH—*contd.*		
199	*Ganna perna aur shakar banana.* (Urdu and Hindi). Leaflet No. 7 of the Department of Agriculture, United Provinces.	Issued by the Department of Agriculture, United Provinces.	Government Printing and Stationery, United Provinces, Allahabad.
200	The Manufacture of White Sugar by the Open Pan System in the Punjab. Leaflet No. 110 of the Department of Agriculture, Punjab.	Issued by the Department of Agriculture, Punjab.	Government Printing, Punjab, Lahore.
201	Sugarcane cultivation and present Prospectus of a White Sugar Industry in Burma. Burma Department of Agriculture, Bulletin No. 28 of 1933.	Issued by the Department of Agriculture, Burma.	Government Printing, Burma, Rangoon.
202	Sugarcane in Burma with a Note on the possibility of White Sugar Manufacture in the Pyinmana area. Agricultural, Survey No. 19 of 1934.	Ditto . . .	Ditto.
203	A Rough Survey of suitable Sugarcane areas in Kyaukse District.	Ditto . . .	Ditto.
204	A Preliminary Note on the Single Pan Method of Manufacturing *Khandsari* Sugar. Bihar and Orissa Department of Agriculture, Bulletin No. 3 of 1933.	Issued by the Department of Agriculture, Bihar and Orissa.	Government Press, Bihar and Orissa, Gulzarbagh.
205	Scientific Report of the Sugarcane Research Station for the year ending 31st March 1933. Bihar and Orissa Department of Agriculture, Bulletin No. 5 of 1933.	Ditto . . .	Ditto.
206	Instructions for the Manufacture of *Khandsari* Sugar. Bihar and Orissa, Department of Agriculture, Bulletin No. 1 of 1934.	Ditto . . .	Ditto.
207	Performance of Coimbatore Sugarcane Seedlings in Bihar and Orissa. Bihar and Orissa Department of Agriculture, Bulletin No. 4 of 1034. (Summary).	Ditto . . .	Ditto.

List of Agricultural Publications in India published during 1933-35—contd.

No.	Title	Author	Where published
	SUGAR RESEARCH—*concld.*		
208	Instructions for the Manufacture of *Gur*. Bihar and Orissa Department of Agriculture, Leaflet No. 1 of 1934.	Issued by the Department of Agriculture, Bihar and Orissa.	Government Press, Bihar and Orissa, Gulzarbagh.
209	Profits from new and ratoon canes (English and Hindi). Leaflet of the Department of Agriculture, Central Provinces.	Issued by the Department of Agriculture, Central Provinces.	Government Printing, Central Provinces, Nagpur.
210	Cultivation of Sugarcane (Hindi). Institute of Plant Industry, Leaflet No. 4 of 1934.	Issued by the Institute of Plant Industry, Indore.	Institute of Plant Industry, Indore.
211	The Improved Method of *Gur* manufacture. Leaflet No. 5 of the Institute of Plant Industry, Indore.	Issued by the Director, Institute of Plant Industry, Indore.	Ditto.
212	Development of Sugar Industry in Mysore. Price, As. 8.	L. C. Coleman . .	Bangalore Press, Bangalore.
	COTTON TECHNOLOGY.		
213	Cotton Research in India, being an account of the work done at the Indian Central Cotton Committee Technological Laboratory, 1924-35 (with a foreword by Diwan Bahadur Sir T. Vijayaraghavacharia, K.B.E.).	Nazir Ahmad . .	Indian Central Cotton Committee, Bombay.
214	Spinning Test Report (No. 498) on Samples of Karunganni Cotton, 1933-34. Price, As. 4.	Issued by the Secretary, Indian Central Cotton Committee, Bombay.	Ditto.
215	Spinning Test Report (No. 503) on Samples of Navsari Cotton, 1933-34. Price, As. 4.	Ditto . .	Ditto.
216	Spinning Test Report (No. 504) on samples of Cambodia Cotton, 1933-34. Price, As. 4.	Ditto . . .	Ditto.
217	Spinning Test Report (No. 509) on samples of Kadiviramgam Cotton, 1933-34. Price, As. 4.	Ditto . . .	Ditto.
218	Spinning Test Report (No. 510) on samples of Tinnevelly Cotton, 1933-34. Price, As. 4.	Ditto . . .	Ditto.

List of Agricultural Publications in India published during 1933-35—contd.

No.	Title	Author	Where published
	COTTON TECHNOLOGY—*contd.*		
219	Spinning Test Report (No. 511) on samples of Bagalkot Cotton, 1933-34. Price, As. 4.	Issued by the Secretary, Indian Central Cotton Committee, Bombay.	Indian Central Cotton Committee, Bombay.
220	Spinning Test Report (No. 514) on samples of A. R. Kampala, A. R. Busoga, and A. R. Jinga Cottons, 1933-34. Price, As. 4.	Ditto . . .	Ditto.
221	Spinning Test Report (No. 515) on samples of Bijapur Cotton, 1933-34. Price, As. 4.	Ditto . . .	Ditto.
222	Spinning Test Report (No. 516) on samples of Upland Cotton, 1933-34. Price, As. 4.	Ditto . .	Ditto.
223	Spinning Test Report (No. 517) on samples of Karunganni Cotton, 1933-34. Price, As. 4.	Ditto . . .	Ditto.
224	Technological Report on Verum 262 (Nagpur), 1934-35. Price, As. 4.	Ditto . . .	Ditto.
225	Technological Report on Verum 262 (Akola), 1934-35. Price, As. 4.	Ditto . . .	Ditto.
226	Technological Report on Umri Bani, 1934-35. Price, As. 4.	Ditto . . .	Ditto.
227	Technological Report on Punjab-American 289-F, 1934-35. Price, As. 4.	Ditto . . .	Ditto.
228	Technological Bulletin, Series A, No. 26, Technological Reports on Standard Indian Cottons, 1934. Price, Re. 1-8-0.	Ditto . . .	Ditto.
229	Statistical Leaflet No. 2 of 1933-34. Stocks of Indian Raw Cotton held in India by the Mills and the Trade on 31st August 1934. Price, Anna 1.	Ditto . . .	Ditto.
230	Statistical Leaflet No. 3 of 1933-34. Receipts at Mills in India of Raw Cotton classified by varieties, 1933-34 season. Price, Anna 1.	Ditto . . .	Ditto.

List of Agricultural Publications in India published during 1933-35—contd.

No.	Title	Author	Where published
	COTTON TECHNOLOGY—*contd.*		
231	Statistical Leaflet No. 4 of 1933-34. Exports by sea of Indian Raw Cotton classified by varieties, 1933-34 season. Price, Anna 1.	Issued by the Secretary, Indian Central Cotton Committee, Bombay.	Indian Central Cotton Committee, Bombay.
232	Combing of good quality Indian Cotton. Technological Bulletins, Series A, No. 27. Price Re. 1.	R. P. Richardson and Nazir Ahmed.	Ditto.
233	Effect of storage prior to ginning on the spinning Quality of Cotton. Technological Bulletins, Series B, No. 19. Price As. 8.	Nazir Ahmed . .	Ditto.
234	Report on the staple length of the Indian Cotton Crop of 1934-35 season. Statistical Leaflet No. 1.	Issued by the Secretary, Indian Central Cotton Committee, Bombay.	Ditto.
235	Spinning Test Report (No. 438) on Samples of Khandesh and Bengal Cottons, 1933-34. Indian Central Cotton Committee Technological Circular No. 112.	Issued by the Secretary, Indian Central Cotton Committee, Bombay, and Director, Technological Laboratory.	Ditto.
236	Spinning Test Report (No. 440) on Samples of Ujjain Cotton, 1933-34. Indian Central Cotton Committee Technological Circular No. 113.	Ditto . . .	Ditto.
237	Technological Report on Punjab-American 289F, 1933-34. Indian Central Cotton Committee Technological Circular No. 114.	Ditto . . .	Ditto.
238	Technological Report on Verum 262 (Nagpur), 1933-34. Indian Central Cotton Committee Technological Circular No. 115.	Ditto . .	Ditto.
239	Spinning Test Report (No. 443) on Samples of C. P. No. 1 and Berar Cottons, 1933-34. Indian Central Cotton Committee Technological Circular No. 116.	Ditto . . .	Ditto.

List of Agricultural Publications in India published during 1933-35—contd.

No.	Title	Author	Where published
	COTTON TECHNOLOGY—*contd.*		
240	Spinning Test Report (No. 444) on Samples of Khandesh Cotton, 1933-34. Indian Central Cotton Committee Technological Circular No. 117.	Issued by the Secretary, Indian Central Cotton Committee, Bombay, and Director, Technological Laboratory.	Indian Central Cotton Committee, Bombay.
241	Spinning Test Report (No. 446) on Samples of Ujjain (Mandsaur) Cotton 1933-34. Indian Central Cotton Committee Technological Circular No. 118.	Ditto .	Ditto.
242	Spinning Test Report (No. 447) on Samples of Moglai Cotton, 1933-34. Indian Central Cotton Committee Technological Circular No. 119.	Ditto .	Ditto.
243	Technological Report on Punjab-American 4-F, 1933-34. Indian Central Cotton Committee Technological Circular No. 120.	Ditto .	Ditto.
244	Spinning Test Report (No. 457) on Samples of Muttia Cotton 1933-34. Indian Central Cotton Committee Technological Circular No. 121.	Ditto .	Ditto.
245	Spinning Test Report (No. 458) on samples of Latur and Nanded Cottons, 1933-34. Indian Central Cotton Committee Technological Circular No. 122.	Ditto .	Ditto.
246	Spinning Test Report (No. 462) on Samples of Hubli Kumpta and Hubli Upland Cottons, 1933-34. Indian Central Cotton Committee Technological Circular No. 123.	Ditto .	Ditto.
247	Spinning Test Report (No. 463) on Samples of Broach and Surat Cottons, 1933-34. Indian Central Cotton Committee Technological Circular No. 124.	Ditto .	Ditto.

List of Agricultural Publications in India published during 1933-35—contd.

No.	Title	Author	Where published
	COTTON TECHNOLOGY—*contd.*		
248	Spinning Test Report (No. 464) on Samples of Punjab-American Cotton, 1933-34. Indian Central Cotton Committee Technological Circular No. 125.	Issued by the Secretary, Indian Central Cotton Committee, Bombay, and Director, Technological Laboratory.	Indian Central Cotton Committee, Bombay.
249	Spinning Test Report (No. 467) on Samples of Western and Miraj Cottons, 1933-34. Indian Central Cotton Committee Technological Circular No. 126.	Ditto .	Ditto.
250	Technological Report on Surat 1027 A. L. F., 1933-34. Indian Central Cotton Committee Technological Circular No. 127.	Ditto .	Ditto.
251	Technological Report of Hagari, I, 1933-34. Indian Central Cotton Committee Technological Circular No. 128.	Ditto .	Ditto.
252	Technological Report on Cambodia Co. 2, Cambodia (440), 1933-34. Indian Central Cotton Committee Technological Circular No. 129.	Ditto .	Ditto.
253	Technological Report on Gadag, I (Dharwar-American), 1933-34. Indian Central Cotton Committee Technological Circular No. 130.	Ditto .	Ditto.
254	Spinning Test Report (No. 469) on Samples of Surat and Tirupur Cambodia Cottons, 1933-34. Indian Central Cotton Committee Technological Circular No. 131.	Ditto .	Ditto.
255	Spinning Test Report (No. 470) on Farm Western Cotton, 1933-34. Indian Central Cotton Committee Technological Circular No. 132.	Ditto .	Ditto.
256	Spinnning Test Report (No. 471) on Samples of Kumpta Cotton, 1933-34. Indian Central Cotton Committee Technological Circular No. 133.	Ditto .	Ditto.

List of Agricultural publications in India published during 1933-35—contd.

No.	Title	Author	Where published
	COTTON TECHNOLOGY—*contd.*		
257	Spinning Test Report (No. 472) on Samples of Jagadia Cotton, 1933-34. Indian Central Cotton Committee Technological Circular No. 134.	Issued by the Secretary, Indian Central Cotton Committee, Bombay, and Director, Technological Laboratory.	Indian Central Cotton Committee, Bombay.
258	Technological Report on Jayawant (Kumpta), 1933-34. Indian Central Cotton Committee Technological Circular No. 135. Price, As. 4.	Ditto	Ditto.
259	Spinning Test Report (No. 481) on Samples of Dholleras Cotton, 1933-34. Indian Central Cotton Committee Technological Circular No. 136. Price, As. 4.	Issued by the Secretary, Indian Central Cotton Committee, Bombay.	Ditto.
260	Spinning Test Report (No. 482) on Samples of Kalagin Cotton, 1933-34. Indian Central Cotton Committee Technological Circular No. 137. Price, As. 4.	Ditto	Ditto.
261	Spinning Test Report (No. 483) on Samples of Western Cottons, 1933-34. Indian Central Cotton Committee Technological Circular No. 138. Price, As. 4.	Ditto	Ditto.
262	Spinning Test Report (No. 487) on Samples of Bailhongal Cotton, 1933-34. Indian Central Cotton Committee Technological Circular No. 139. Price, As. 4.	Ditto	Ditto.
263	Spinning Test Report (No. 488) on Samples of Farm Western and Tiruppur Cambodia Cottons, 1933-34. Indian Central Cotton Committee Technological Circular No. 140. Price, As. 4.	Ditto	Ditto.
264	Spinning Test Report (No. 489) on Samples of Broach Cotton, 1933-34. Indian Central Cotton Committee Technological Circular No. 141. Price, As. 4.	Ditto	Ditto.

List of Agricultural Publications in India published during 1933-35—contd.

No.	Title	Author	Where published
	COTTON TECHNOLOGY—*contd.*		
265	Spinning Test Report (No. 490) on Samples of Jagadia Cotton, 1933-34. Indian Central Cotton Committee Technological Circular No. 142. Price, As. 4.	Issued by the Secretary, Indian Central Cotton Committee, Bombay.	Indian Central Cotton Committee, Bombay.
266	Spinning Test Report (No. 491) on Samples of Bawla and Kadi Cottons, 1933-34. Indian Central Cotton Committee Technological Circular No. 143. Price, As. 4.	Ditto .	Ditto.
267	Spinning Test Report (No. 559) on Samples of C. P. No. 1 Cotton, 1934-35. Technological Circular No. 158. Price, As. 4.	Ditto .	Ditto.
268	Spinning Test Report (No. 560) on Samples of Berar Cotton, 1934-35. Technological Circular No. 159. Price, As. 4.	Ditto .	Ditto.
269	Spinning Test Report (No. 561) on Samples of Khandesh Cotton, 1934-35. Technological Circular No. 160. Price, As. 4.	Ditto .	Ditto.
270	Spinning Test Report (No. 566) on Samples of Khandesh Cotton, 1934-35. Technological Circular No. 161. Price, As. 4.	Ditto .	Ditto.
271	Spinning Test Report (No. 567) on Samples of Moglai Cotton, 1934-35. Technological Circular No. 162. Price, As. 4.	Ditto .	Ditto.
272	Spinning Test Report (No. 568) on Samples of Bengal Cotton, 1934-35. Technological Circular No. 163. Price, As. 4.	Ditto .	Ditto.
273	Spinning Test Report (No. 570) on Samples of Ujjain (Ujjain) Cotton, 1934-35. Technological Circular No. 164. Price, As. 4.	Ditto .	Ditto.

List of Agricultural Publications in India published during 1933-35—contd.

No.	Title	Author	Where published
	COTTON TECHNOLOGY—*contd.*		
274	Spinning Test Report (No. 571) on Samples of Ujjain (Mandsaur) Cotton, 1934-35. Technological Circular No. 165. Price, As. 4.	Issued by the Secretary, Indian Central Cotton Committee, Bombay.	Indian Central Cotton Committee, Bombay.
275	Spinning Test Report (No. 577) on Samples of Hubli Kumpta Cotton, 1934-35. Technological Circular No. 166. Price, As. 4.	Ditto .	Ditto.
276	Technological Report on Gadag I (Dharwar-American), 1934-35. Technologial Circular No. 167. Price, As. 4.	Ditto .	Ditto.
277	Spinning Test Report (No. 582) on Samples of Latur Cotton, 1934-35. Technological Circular No. 168. Price, As. 4.	Ditto .	Ditto.
278	Spinning Test Report (No. 583) on Samples of Nanded Cotton, 1934-35. Technological Circular No. 169. Price, As. 4.	Ditto .	Ditto.
279	Spinning Test Report (No. 584) on Samples of Muttia Cotton, 1934-35. Technological Circular No. 170. Price, As. 4.	Ditto .	Ditto.
280	Spinning Test Report (No. 591) on Samples of Broach Cotton, 1934-35. Technological Circular No. 171. Price, As. 4.	Ditto .	Ditto.
281	Spinning Test Report (No. 592) on Samples of Jagadia Cotton, 1934-35. Technological Circular No. 172. Price, As. 4.	Ditto .	Ditto.
282	Spinning Test Report (No. 595) on Samples of Bailhongal Cotton, 1934-35. Technological Circular No. 174. Price, As. 4.	Ditto .	Ditto.
283	Spinning Test Report (No. 596) on Samples of Broach Cotton, 1934-35. Technological Circular No. 175. Price, As. 4.	Ditto .	Ditto.

List of Agricultural Publications in India published during 1933-35—contd.

No.	Title	Author	Where published
	COTTON TECHNOLOGY—*contd.*		
284	Spinning Test Report (No. 597) on Samples of Karunganni Cotton, 1934-35. Technological Circular No. 176. Price, As. 4.	Issued by the Secretary, Indian Central Cotton Committee, Bombay.	Indian Central Cotton Committee, Bombay.
285	Spinning Test Report (No. 598) on Samples of Tiruppur Cambodia Cotton, 1934-35. Technological Circular No. 177. Price, As. 4.	Ditto .	Ditto.
286	Spinning Test Report (No. 599) on Samples of Northern Cambodia Cotton, 1934-35. Technological Circular No. 178. Price, As. 4.	Ditto .	Ditto.
287	Spinning Test Report (No. 600) on Samples of Farm Westerns Cotton, 1934-35. Technological Circular No. 179. Price, As. 4.	Ditto ..	Ditto.
288	Spinning Test Report (No. 602) on Samples of Miraj Cotton, 1934-35. Technological Circular No. 181. Price, As. 4.	Ditto .	Ditto.
289	Spinning Test Report (No. 603) on Samples of Nandyal Cotton, 1934-35. Technological Circular No. 182. Price, As. 4.	Ditto .	Ditto.
290	Spinning Test Report (No. 604) on Samples of Surat Cotton, 1934-35. Technological Circular No. 183. Price, As. 4.	Ditto .	Ditto.
291	Spinning Test Report (No. 606) on Samples of Tiruppur Cambodia Cotton, 1934-35. Technological Circular No. 184. Price, As. 4.	Ditto .	Ditto.
292	Spinning Test Report (No. 607) on Samples of African Busoga Cotton, 1934-35. Technological Circular No. 185. Price, As. 4.	Ditto .	Ditto.
293	Spinning Test Report (No. 608) on Samples of Kampala Cotton, 1934-35. Technological Circular No. 186. Price, As. 4.	Ditto .	Ditto.

List of Agricultural Publications in India published during 1933-35—contd.

No.	Title	Author	Where published
	COTTON TECHNOLOGY—*concld.*		
294	Spinning Test Report (No. 609) on Samples of Hubli Upland Cotton, 1934-35. Technological Circular No. 187. Price, As. 4.	Issued by the Secretary, Indian Central Cotton Committee, Bombay.	Indian Central Cotton Committee, Bombay.
295	Technological Report on Punjab-American 4-F, 1934-35. Technological Circular No. 188. Price, As. 4.	Ditto .	Ditto.
296	Report on the staple length of the Indian Cotton Crop of the 1933-34 season. Statistical leaflet No. 1 of 1933-34. Price, As. 2.	Ditto .	Ditto.
	FRUITS.		
297	Report of the Committee on the Improvement in the Marketing of Fruit and Vegetables in the town of Bombay, 1934. Price, Re. 1.	Issued by the Committee appointed by Bombay Government.	Government Central Press, Bombay.
298	The Planting and Early Care of Young Fruit Trees (Urdu and Hindi). United Provinces Department of Agriculture, Fruit Series Bulletin No. 1.	W. Head .	Government Printing and Stationery, United Provinces, Allahabad.
299	The Papaya or *Papeeta* (Urdu and Hindi). United Provinces Department of Agriculture, Fruit Series Bulletin No. 2.	Ditto .	Ditto.
300	Orchards, their making and maintenance in the Plains of the United Provinces (revised). United Provinces Department of Agriculture, Fruit Series Bulletin No. 14.	Ditto .	Ditto.
301	Strawberry, its cultivation and Economic Possibilities in the United Provinces. United Provinces Department of Agriculture, Fruit Series Bulletin No. 5.	S. R. Swarup .	Ditto.
302	A Note on the Citrus Varieties. United Provinces Department of Agriculture, Fruit Bulletin No. 6.	R. G. Allan .	Ditto.

List of Agricultural Publications in India published during 1933-35—contd.

No.	Title	Author	Where published
	FRUITS—*contd.*		
303	Orchards, their making and maintenance in the Plains of the United Provinces. Hindi and Urdu translations of the United Provinces Department of Agriculture, Bulletin No. 4, Fruit Series.	J. H. Johnson and W. Head.	Government Printing and Stationery, United Provinces, Allahabad.
304	Strawberry, its cultivation and economic possibilities in the United Provinces. Hindi and Urdu translations of the United Provinces Department of Agriculture, Bulletin No. 5, Fruit Series.	S. R. Swarup .	Ditto.
305	Citrus Cultivation. Urdu and Hindi translations of Bulletin No. 6, Fruit Series of the Department of Agriculture, United Provinces.	R. G. Allan .	Ditto.
306	The Guava. Bulletin No. 8, Fruit Series of the Department of Agriculture, United Provinces.	W. S. Smith .	Ditto.
307	Fruit Culture in the Hills. Bulletin No. 10, Fruit Series of the Department of Agriculture, United Provinces.	J. G. Burns .	Ditto.
308	Sundry papers on Fruit Development, Fruit Growers' Organisation and the necessity of improving the basis of marketing. Bulletin No. 11, Fruit Series of the Department of Agriculture, United Provinces.	R. G. Allan .	Ditto.
309	The Guava (Urdu). Bulletin No. 8, Fruit Series of the Department of Agriculture, United Provinces.	W. S. Smith	Ditto.
310	A Note on Pine Apple. Bulletin No. 9, Fruit Series of the Department of Agriculture, United Provinces.	V. Sane .	Ditto.

List of Agricultural Publications in India published during 1933-35—contd.

No.	Title	Author	Where published
	FRUITS—*concld.*		
311	Sundry papers on Fruit Development, Fruit Growers' Organisation and the necessity of improving the basis of marketing (Hindi). Bulletin No. 11, Fruit Series of the Department of Agriculture, United Provinces.	R. G. Allan . . .	Government Printing and Stationery, United Provinces, Allahabad.
312	General Hints on the Manuring of Oranges. Leaflet No. 109 of the Department of Agriculture, Punjab.	Issued by the Department of Agriculture, Punjab.	Government Printing, Punjab, Lahore.
313	Cultivation of *Phalsas*. Punjab Department of Agriculture, Leaflet No. 114.	Ditto . .	Ditto.
314	Preparation of *Phalsas* Syrup and Juice. Punjab Department of Agriculture, Leaflet No. 115.	Ditto . .	Ditto.
315	Lemon Squash and Lemon Juice. Leaflet No. 124 of the Department of Agriculture, Punjab.	Ditto . .	Ditto.
316	Lemon Beverages. Leaflet No. 5 of 1934 of the Department of Agriculture, Bihar and Orissa.	Issued by the Department of Agriculture, Bihar and Orissa.	Government Press, Bihar and Orissa, Gulzarbagh.
317	A Study of the Marketing of Fruits at Calcutta.	Ditto . .	Ditto.
318	Planting an Orange orchard in Chhatisgarh (Hindi) Central Provinces Department of Agriculture Leaflet.	Issued by the Department of Agriculture, Central Provinces.	Government Printing, Central Provinces, Nagpur.
319	How to grow fruits. Assam Department of Agriculture, Bulletin No. 1 of 1933.	Issued by the Department of Agriculture, Assam.	Government Printing, Assam, Shillong.
320	Instruction regarding cultivation of Deciduous Fruit Trees in Kashmir (in vernacular and Issued gratis).	M. R. Fotidar . .	Agricultural Department, Jammu and Kashmir, Srinagar.
	LAC.		
321	Annual Report of the Indian Lac Research Institute, Namkum, Ranchi, Bihar and Orissa, for the year 1933-34.	Issued by the Director, Indian Lac Research Institute, Namkum.	The Indian Lac Research Institute, Namkum, Ranchi.

List of Agricultural Publications in India published during 1933-35—contd.

No.	Title	Author	Where published
		LAC—*contd.*	
322	Advice on the more profitable use of *Kusum* tree (*Schelichera trijuga*) as a lac host. (English, Hindi and Oriya.)	Issued by the Director, Indian Lac Research Institute, Namkum.	The Indian Lac Research Institute, Namkum, Ranchi.
323	A Simple Method for the Forecast of Emergence of Lac Larvae.	P. S. Negi . . .	Ditto.
324	A Simple Method for the Forecast of Emergence of Lac Larvae (Oriya).	Issued by the Director, Indian Lac Research Institute, Namkum.	Ditto.
325	Lac and the Indian Lac Research Institute.	Dorothy Norris, P. M. Glover and R. W. Aldis.	Ditto.
326	Lac Cultivation and Shellac Industry.	P. M. Glover . .	Ditto.
327	The Alimentary Canal, its Appendages, Salivary glands and the Nervous System of the Adult Female Lac Insect, *Laccifer Lacca* (Coccidae).	P. S. Negi . . .	Ditto.
328	The Developmental Stages of *Bracon tachardiae* Cum. (hym.)	P. M. Glover . .	Ditto.
329	Refractive Index of Shellac. Indian Lac Research Institute Bulletin No. 17. Price Re. 1.	A. K. Thakur and R. W. Aldis.	Ditto.
330	Modification of Shellac, Part I. The effect of Sulphur. Indian Lac Research Institute Bulletin No. 18. Price Re. 1.	M. Venugopalan . .	Ditto.
331	The Heat Curing of Shellac, Part II. Depolymenisation. Indian Lac Research Institute Bulletin No. 19.	M. Rangaswami and R. W. Aldis.	Ditto.
332	Further Notes on the use of *Schleichera trijuga* (*Kusum*) in Lac Cultivation. Indian Lac Research Institute Bulletin No. 20.	Dorothy Norris . .	Ditto.
333	A Check List of the Chalcidoidae bred at Namkum from the lac insect *Laccifer lacca* with some notes as regards their function, economic importance and control. Indian Lac Research Institute Bulletin No. 21.	P. M. Glover . .	Ditto.

List of Agricultural Publications in India published during 1933-35—contd.

No.	Title	Author	Where published
	LAC—*concld.*		
334	Treatment of Shellac Varnish with Thiourea and Urea. Indian Lac Research Institute Research Note No. 14.	M. Venugopalan, S. Ranganathan and R. W. Aldis.	The Indian Lac Research Institute, Namkum, Ranchi.
335	The influence of Nitrogenous substances on Shellac bleaching. Issued by the Indian Lac Research Institute.	N. Narasimha Murty and R. W. Aldis.	Ditto.
336	Utilisation of *Kiri* for Plastic Moulding. Indian Lac Research Institute Research Note No. 16.	S. Ranganathan and R. W. Aldis.	Ditto.
337	A further means of dispersing 'Polymerised' Shellac. Indian Lac Research Institute Research Note No. 17.	M. Venugopalan and R. W. Aldis.	Ditto.
338	Some effects of Hydrochloric acid on Shellac Varnish. Indian Lac Research Institute Research Note No. 18.	R. W. Aldis.	Ditto.
339	The Biology of *Holcocera pulverea* Meyr. (Blastobasidæ), its predators, parasites and control.	M. P. Misra and S. N. Gupta.	Ditto.
	AGRICULTURAL SCIENCE—GENERAL.		
340	*The Indian Journal of Agricultural Science*, Vol. III, Parts IV, V and VI, Vol. IV, Parts I to VI, and Vol. V, Parts I, II and III. Annual subscription Rs. 15 or 24*s.* (Original scientific work in the various branches of science applied to agriculture, formerly published in the Memoirs of the Imperial Department of Agriculture in India is now published in the *Indian Journal of Agricultural Science.*)	Issued under the authority of the Imperial Council of Agricultural Research.	Manager of Publications, Delhi.
	BOTANY.		
341	The Bombay Grasses. Scientific Monograph No. 5 of the Imperial Council of Agricultural Research. Price Rs. 20-12 or 32*s.* 6*d.*	E. J. Blatter and C. McCann. Illustrated by B. K. Bhide.	Manager of Publications, Delhi.

List of Agricultural Publications in India published during 1933-35—contd.

No.	Title	Author	Where published
	BOTANY—*contd.*		
342	Influence of Manures on the Wilt Disease of *Cajanus indicus* Spreng and the Isolation of Types Resistant to the Disease. Scientific Monograph No. 7 of the Imperial Council of Agricultural Research. Price Rs. 2-4 or 4*s*. 3*d*.	W. McRae and F. J. F. Shaw.	Manager of Publications, Delhi.
343	Scientific Reports of the Imperial Institute of Agricultural Research, Pusa (including the Reports of the Imperial Dairy Expert, Physiological Chemist and Sugarcane Expert), for 1932-33. Price Rs. 4-12 or 8*s*.	Director, Imperial Institute of Agricultural Research, Civil Lines, Delhi.	Ditto.
344	Scientific Reports of the Imperial Institute of Agricultural Research, Pusa (including the Reports of the Imperial Dairy Expert, Physiological Chemist and Sugarcane Expert), for 1933-34. Price Rs. 4-12 or 8*s*.	Ditto . .	Ditto.
345	Summaries of the Annual Reports of the Experimental work done under the Economic Botanist to Government, Bombay, from 1893 to 1916. Bombay Department of Agriculture Bulletin No. 172 of 1933. Price As. 2.	G. D. Patwardhan and L. S. S. Kumar.	Government Central Press, Bombay.
346	Improved *Jowar* Varieties and their importance in Indian Industries and Trade (English, Urdu and Hindi).	T. S. Sabnis . . .	Government Printing and Stationery, United Provinces, Allahabad.
347	Scientific Report of the Rice Research Station, Sabour, for the year ending 31st March 1933. Bihar and Orissa Department of Agriculture Bulletin No. 4 of 1933.	Issued by the Department of Agriculture, Bihar and Orissa.	Government Press, Bihar and Orissa, Gulzarbagh.
348	Scientific Report of the Rice Research Station, Sabour, for the year ending 31st March 1934. Bihar and Orissa Department of Agriculture Bulletin No. 4 of 1934.	Ditto . .	Ditto.

List of Agricultural Publications in India published during 1933-35—contd.

No.	Title	Author	Where published
	BOTANY—*concld.*		
349	Reports on the Botanical Research, Agricultural College, Nagpur, for the year ending the 31st March 1932.	Issued by the Department of Agriculture, Central Provinces.	Government Printing, Central Provinces, Nagpur.
350	Report on the Botanical Research, Agricultural College, Nagpur, for the year ending the 31st March 1933.	Ditto . .	Ditto.
351	Report on the Botanical Research, Agricultural College, Nagpur, for the year ending the 31st March 1934.	Ditto . .	Ditto.
	CHEMISTRY AND PHYSICAL CHEMISTRY.		
352	Making of Pouderette from Night Soil (English). Leaflet No. 67 of the Department of Agriculture, Madras.	P. V. Ramiah . .	Government Press, Madras.
353	Report on investigation on a New and Simple Process for the Manufacture of Active Charcoal from Paddy husk and on the manufacture of "Cream Jaggery" using the Active Carbon. Bulletin No. 39 of the Department of Agriculture, Madras. Price As. 10.	B. Viswanath . .	Ditto.
354	Composition of important manures and manurial constituents of important crops in Western India. Bombay Department of Agriculture Bulletin No. 174 of 1933. Price As. 2.	D. L. Sahassrabuddhe .	Government Central Press, Bombay.
355	Experiments in Manuring Crops in the Bombay Presidency, 1896-1931. Price Rs. 2-9-0.	Ditto . .	Ditto.
356	Detailed Scientific Report of the Agricultural Chemist, Bihar and Orissa, on the nature of Sand Deposits in the Earthquake affected areas. Bihar and Orissa Department of Agriculture Bulletin No. 3 of 1934.	Issued by the Department of Agriculture, Bihar and Orissa.	Government Press, Bihar and Orissa, Gulzarbagh.

List of Agricultural Publications in India published during 1933-35—contd.

No.	Title	Author	Where published
	CHEMISTRY AND PHYSICAL CHEMISTRY—*contd.*		
357	The use of Artificial Manures in North Bihar, with special reference to their value in growing Crops on Sand affected lands. Bihar and Orissa Department of Agriculture Leaflet No. 3 of 1934.	Issued by the Department of Agriculture, Bihar and Orissa.	Government Press, Bihar and Orissa, Gulzarbagh.
358	Report on the Chemical Research, Agricultural College, Nagpur, for the year ending the 31st March 1932.	Issued by the Department of Agriculture, Central Provinces, Nagpur.	Government Printing, Central Provinces, Nagpur.
359	Report on the Chemical Research, Agricultural College, Nagpur, for the year ending the 31st March 1933.	Ditto . .	Ditto.
360	A Decennial Review of Biochemical Investigations on Soils carried out in the Central Provinces and Berar (Hindi and Marathi).	Ditto . .	Ditto.
361	Irwin Canal Soil Survey Report. Series No. 1. Introductory and General Part. Price As. 8.	B. Narasimha Iyengar .	Superintendent, Government Press, Bangalore.
362	The preparation of Bone-Char Manure. Leaflet No. 10.	Issued by the Director, Institute of Plant Industry, Indore.	The Director, Institute of Plant Industry and Agricultural Adviser to States in Central India and Rajputana, Indore.
363	The making of Rain-watered Compost Manure from Farm Wastes. (Revised.) Leaflet No. 2.	Ditto . .	Ditto.
364	Studies on the Pectic Substances in Tea. Bulletin No. 6. Price Re. 1 for members and Rs. 2 for non-members.	Issued by the Secretary, United Planters' Association of Southern India.	The Secretary, United Planters' Association of Southern India, Glenview, Coonoor, Nilgiris.
365	The Nitrogen Distribution in Tea. Bulletin No. 7. Price Re. 1 for members and Rs. 2 for non-members.	Ditto . .	Ditto.
366	The Aroma of Tea. Bulletin No. 8. Price Re. 1 for members and Rs. 2 for non-members.	Ditto . .	Ditto.

List of Agricultural Publications in India published during 1933-35—contd.

No.	Title	Author	Where published
	CHEMISTRY AND PHYSICAL CHEMISTRY—*contd.*		
367	An Investigation of the Rise of Water-table in the Upper Chenab Canal area, Punjab. *Memoirs Punjab Irrigation Research Institute, Lahore,* Volume I, No. 4. Price As. 12.	E. McKenzie Taylor, J. K. Malhotra and M. L. Mehta.	Superintendent, Government Printing, Punjab, Lahore.
368	A Statistical Examination of the uplift Pressure Data obtained from Model Experiments. *Memoirs Punjab Irrigation Research Institute, Lahore,* Volume I, No. 5. Price As. 10.	J. K. Malhotra and Harbans Lal Uppal.	Ditto.
369	Studies on Sub-soil Hydraulics. Investigation of Observational Methods for Models. *Memoirs Punjab Irrigation Research Institute, Lahore,* Volume II, No. 2. Price Rs. 1-2.	Harbans Lal Uppal and J. P. Gunn.	Ditto.
370	A Study of the Flow of Water under works on Sand Foundations by means of Models. *Memoirs Punjab Irrigation Research Institute, Lahore,* Volume II, No. 3. Price As. 4.	E. McKenzie Taylor and Harbans Lal Uppal.	Ditto.
371	A Study of the Flow of Water under Works on Sand Foundations by means of Models, Part II. *Memoirs Punjab Irrigation Research Institute, Lahore,* Volume II, No. 4. Price As. 3.	Ditto . .	Ditto.
372	An Investigation of the Pressures on Works on Sand Foundations, I. *Memoirs Punjab Irrigation Research Institute, Lahore,* Volume II, No. 5. Price Re. 1.	Ditto . .	Ditto.
373	An Investigation of the Flow of Water under Khanki Weir and the Pressures on the Floor. *Memoirs Punjab Irrigation Research Institute, Lahore,* Volume II, No. 6. Price Re. 1.	Ditto . .	Ditto.

List of Agricultural Publications in India published during 1933-35—contd.

No.	Title	Author	Where published
	CHEMISTRY AND PHYSICAL CHEMISTRY—*contd.*		
374	A Siltometer for studying size Distribution of Silts and Sands. *Memoirs Punjab Irrigation Research Institute, Lahore,* Volume II, No. 7. Price As. 5.	A. N. Puri . . .	Superintendent, Government Printing, Punjab, Lahore.
375	Protection below Khanki Weir. *Memoirs Punjab Irrigation Research Institute, Lahore,* Volume II, No. 8. Price As. 4.	J. P. Gunn . . .	Ditto.
376	Influence of upstream sheet Pile on the uplift Pressure on works, with an introduction by the Director, Irrigation Research, Punjab. *Memoirs Punjab Irrigation Research Institute, Lahore,* Volume II, No. 9. Price Rs. 1-4.	N. K. Bose and Harbans Lal Uppal.	Ditto.
377	An Irrigation of the uplift Pressure on a Model of Bay IV Khanki Weir and the Prototype. *Memoirs Punjab Irrigation Research Institute, Lahore,* Volume II, No. 10. Price As. 10.	A. N. Khosla, E. Mckenzie Taylor and Harbans Lal Uppal.	Ditto.
378	The Relation between Exchangeable Sodium and Crop yield in Punjab soils and a New Method of Characterising Alkali soils. *Memoirs Punjab Irrigation Research Institute, Lahore,* Volume IV, No. 5. Price As. 2.	Amar Nath Puri . .	Ditto.
379	A simple Method for Determining the Reaction and Titration curves of Soils. *Memoirs Punjab Irrigation Research Institute, Lahore,* Volume IV, No. 6. Price As. 2.	Balmukand Anand and Amar Nath Puri.	Ditto.
380	Soil Deterioration of the Canal Irrigated Areas of the Punjab. *Memoirs Punjab Irrigation Research Institute, Lahore,* Volume IV, No. 7. Price As. 8.	E. McKenzie Taylor, A. N. Puri and A. G. Asghar.	Ditto.

List of Agricultural Publications in India published during 1933-35—contd.

No.	Title	Author	Where published
	CHEMISTRY AND PHYSICAL CHEMISTRY—*concld.*		
381	Relation between Degree of Alkalisation and Dispersion co-efficient in Alkali soils. *Memoirs Panjab Irrigation Research Institute, Lahore,* Volume IV, No. 8. Price, As. 4.	A. G. Asghar, A. N. Puri and E. McKenzie Taylor.	Superintendent, Government Printing, Punjab, Lahore,
382	An Optical Lever Siltometer. *Memoirs Punjab Irrigation Research Institute, Lahore,* Volume V, No. 1. Price Re. 1.	V. I. Vaidhianathan	Ditto.
383	The Transmission Co-efficient of water in Natural silts. *Memoirs Punjub Irrigation Research Institute, Lahore,* Volume V, No. 2. Price As. 5.	V. I. Vaidhianathan and Hans Raj Luthra.	Ditto.
384	Study of the Evaporation of water from a soil surface with reference to the Fluctuations of Water-Table. *Memoirs Punjab Irrigation Research Institute, Lahore,* Volume V, No. 3. Price As. 3.	Ditto	Ditto.
385	On the Electrical Method of Investigating the Uplift Pressures under Dams and Weirs. *Memoirs Punjab Irrigation Research Institute, Lahore,* Volume V, No. 4.	V. I. Vaidhianathan and Gurdas Ram.	Ditto.
386	A Gravitational Survey of the Sub-alluvium of the Jhelum, Chenab, Ravi Doabs and its Applications to Problems of Waterlogging. *Memoirs Punjab Irrigation Research Institute, Lahore,* Volume VI, No. 1. Price Rs. 5.	B. H. Wilsdon and N. K. Bose.	Ditto.
	PLANT DISEASES		
387	Influence of Manures on the Wilt Disease of *Cajanus indicus* Spreng and isolation of Types resistant to the Disease. Scientific Monograph No. 7 of the Imperial Council of Agricultural Research. Price Rs. 2-4 or 4*s.* 3*d.*	W. McRae and F. J. F. Shaw.	Manager of Publications, Delhi.

List of Agricultural Publications in India published during 1933-35—contd.

No.	Title	Author	Where published
	PLANT DISEASES—*contd.*		
388	Keleroga or *Mahali* disease of Arecanuts (English, Tamil, Telugu, Kanarese and Malayalam). Madras Department of Agriculture Leaflet No. 53.	S. Sundararamier . .	Government Press, Madras.
389	The Fungi of Bombay. Bulletin No. 176 of 1934 of the Department of Agriculture, Bombay. Price As. 12.	B. N. Uppal, M. K. Patel and M. N. Kamat.	Government Central Press, Bombay.
390	Some common Fungoid Diseases of Crops and their preventive measure (Review) (English and Bengali).	Issued by the Department of Agriculture, Bengal.	Bengal Government Press, Alipur.
391	Fungus Diseases of Betelvine (*pan*) and their treatment. Leaflet No. 1 of 1934 of the Department of Agriculture, Bengal.	Ditto . .	Bengal Secretariat Depot, Calcutta.
392	Red Rot of Sugarcane. United Provinces Department of Agriculture Bulletin No. 66.	P. K. Dey . .	Government Printing and Stationery, United Provinces, Allahabad.
393	Red Rot of Sugarcane (Urdu and Hindi). Leaflet of the United Provinces Department of Agriculture.	Ditto . .	Ditto.
394	Mosaic Disease of Potatoes (Urdu and Hindi).	Ditto . .	Ditto.
395	Two Common Diseases of Citrus Trees in the United Provinces (Urdu and Hindi). Bulletin No. 7, Fruit Series of the Department of Agriculture, United Provinces.	Ditto . .	Ditto.
396	Ear Cockle Disease of Wheat. Leaflet No. 127 of the Department of Agriculture, Punjab.	Issued by the Department of Ariculture, Punjab.	Government Printing, Punjab, Lahore.
397	A Simple Method of Treating Oat Seed against Smut. Bihar and Orissa, Department of Agriculture Leaflet No. 4 of 1934.	Issued by the Department of Agriculture, Bihar ond Orissa.	Government Press, Bihar and Orissa, Gulzarbagh.

List of Agricultural Publications in India published during 1933-35—contd.

No.	Title	Author	Where published
	PLANT DISEASES—*concld.*		
398	A Method of Prevention of Smut in *Jowar* (Revised). (English, Hindi and Marathi.) Leaflet of the Department of Agriculture, Central Provinces.	Issued by the Department of Agriculture, Central Provinces.	Government Printing, Central Provinces, Nagpur.
399	Control of *Jowar* Smut (Revised). (English, Marathi and Hindi.) Leaflet of the Department of Agriculture, Central Provinces.	Ditto . .	Ditto.
400	Report on the Mycological Research, Agricultural College, Nagpur for the year ending 31st March 1932.	Ditto . .	Ditto.
401	Report on the Mycological Research, Agricultural College, Nagpur for the year ending 31st March 1933.	Ditto . .	Ditto.
402	A Leaflet on the " Gangai " or 'Ponga' disease of Rice Crop (English and Hindi).	Ditto . .	Ditto.
403	Report on the Disease of the Coconut Palm. Leaflet of the Department of Agriculture, Travancore.	M. K. Varghese . .	The Director of Agriculture and Fisheries, Travancore.
	ENTOMOLOGY		
404	List of Publications on Indian Entomology, 1930. Miscellaneous Bulletin No. 1 of the Imperial Council of Agricultural Research. Price As. 14 or 1*s*. 6*d*.	Imperial Entomologist, Pusa.	Manager of Publications, Delhi.
405	List of Publications on Indian Entomology, 1931. Miscellaneous Bulletin No. 2 of the Imperial Council of Agricultural Research. Price As. 8 or 10*d*.	Ditto . .	Ditto.
406	List of Publications on Indian Entomology, 1932. Miscellaneous Bulletin No. 3 of the Imperial Council of Agricultural Research. Price As. 12 or 1*s*. 3*d*.	Ditto . .	Ditto.

List of Agricultural Publications in India published during 1933-35—contd.

ENTOMOLOGY—*contd.*

No.	Title	Author	Where published
407	Host Plant Index of Indo-Ceylonese Coccidae. Miscellaneous Bulletin No. 4 of the Imperial Council of Agricultural Research. Price Re. 1-10 or 2*s*. 9*d*.	S. Ramachandran and T. V. Ramakrishna Ayyar.	Manager of Publications, Delhi.
408	List of Publications on Indian Entomology, 1933. Miscellaneous Bulletin No. 5 of the Imperial Council of Agricultural Research. Price As. 9 or 1*s*.	Compiled by the Offg. Imperial Entomologist, Pusa.	Ditto.
409	A Pest on Stored Paddy (English, Tamil, Telugu, Kanarese and Malayalam). Leaflet No. 65 of the Department of Agriculture, Madras.	T. V. Ramakrishna Iyer.	Government Press, Madras.
410	The House Fly Nuisance and its control with Maggot Traps (Kanarese and Malayalam). Leaflet No. 64 of the Department of Agriculture, Madras.	Ditto . .	Ditto.
411	Insect and Fungus Pests of Stored Paddy. Leaflet No. 68 of the Department of Agriculture, Madras.	Ditto . .	Ditto.
412	Pamphlet on the Pink Bollworm Pests of Cotton and How to Control it (English, Hindi and Urdu).	Issued by the Secretary, Indian Central Cotton Committee, Bombay.	Indian Central Cotton Committee, Bombay.
413	Some more Injurious Insect Pests of Crops (English and Bengali). Bulletin No. 1 of 1934 of the Department of Agriculture, Bengal.	Issued by the Department of Agriculture. Bengal.	Bengal Government Press, Alipur.
414	Sugarcane Borer (Urdu). Leaflet No. 19 of the Department of Agriculture, United Provinces.	Issued by the Department of Agriculture, United Provinces.	Government Printing and Stationery, United Provinces, Allahabad.
415	Stem Borer of Sugarcane. Leaflet No. 22 of the Department of Agriculture, United Provinces.	Ditto . .	Ditto.
416	Pyrilla Attack on Sugarcane (English and Hindi). Leaflet No. 23 of the Department of Agriculture, United Provinces.	Ditto . .	Ditto.

List of Agricultural Publications in India published during 1933-35—contd.

No.	Title	Author	Where published
	ENTOMOLOGY - *contd.*		
417	Damage caused by Insects on some commonly grown Fruits in the Plains of the United Provinces, control method and material (Hindi). United Provinces Department of Agriculture Fruit Series Bulletin No. 3.	P. B. Richards . .	Government Printing and Stationery, United Provinces, Allahabad.
418	Sugarcane Top-borer. Punjab Department of Agriculture Leaflet No. 112.	Issued by the Department of Agriculture, Punjab.	Government Printing, Punjab, Lahore.
419	Directions for the protection of stored grains from attack of *Susti*, *Thora* and *Khapra*. Punjab Department of Agriculture Leaflet No. 113.	Ditto . .	Ditto.
420	The New Pyralid Borer of Sugarcane. Leaflet No. 116 of the Department of Agriculture, Punjab.	Ditto . .	Ditto.
421	A Note on Pests and Diseases of *Rabi* Crops. Leaflet No. 119 of the Department of Agriculture, Punjab.	Ditto . .	Ditto.
422	A Note on Pests and Diseases of *Kharif* Crops. Leaflet No. 120 of the Department of Agriculture, Punjab.	Ditto . .	Ditto.
423	A Note on Pests of Fruit Trees and Vegetables. Leaflet No. 121 of the Department of Agriculture, Punjab.	Ditto . .	Ditto.
424	A New Insect Pest of Rice in the Sheikhupura and Gujranwala Districts. Leaflet No. 123 of the Department of Agriculture, Punjab.	Ditto . .	Ditto.
425	Report on the Entomological Research, Agricultural College, Nagpur, for the year ending 31st March 1932.	Issued by the Department of Agriculture, Central Provinces.	Government Printing, Central Provinces, Nagpur.
426	Report on the Entomological Research, Agricultural College, Nagpur, for the year ending 31st March 1933.	Ditto . .	Ditto.

List of Agricultural Publications in India published during 1933-35—contd.

No.	Title	Author	Where published
	ENTOMOLOGY—*concld.*		
427	Inderbala, a Serious Pest of Orange, Guava and Peach and its control (English, Hindi and Marathi). Leaflet of the Department of Agriculture, Central Provinces.	Issued by the Department of Agriculture, Central Provinces.	Government Printing, Central Provinces, Nagpur.
428	Bee-keeping. Bulletin No. 4 (1934) of the Department of Agriculture, Assam.	Issued by the Department of Agriculture, Assam.	Government Press, Assam, Shillong.
429	Sugarcane Borers and their Control in the Mysore State. Circular No. 53 of the Department of Agriculture, Mysore.	Issued by the Department of Agriculture, Mysore.	Government Press, Bangalore.
430	Bee-keeping. A subsidiary occupation for the Raiyats. Price As. 8.	T. V. Subramaniam and B. Krishnamurthy.	Bangalore Press, Bangalore City.
431	The Coffee Stem Borer. Price As. 8.	T. V. Subramaniam .	Ditto.
432	Instructions regarding control of San Jose Scale Pest in Kashmir (vernacular, issued gratis).	M. R. Fotidar . .	Agricultural Department, Jammu and Kashmir, Srinagar.
433	Surface Cut Worm and its Control Measures (vernacular, issued gratis).	Jia Lal Raina . .	Ditto.
434	Control of San Jose Scale Pest in Kashmir (in popular Kashmir verse, issued gratis).	Jia Lal Raina and P. Gawash Koul.	Ditto.
	SERICULTURE.		
435	The Silk Industry of Japan, with Notes on Observations in United States of America, England, France and Italy. Scientific Monograph No. 8 of the Imperial Council of Agricultural Research. Price Rs. 4 or 6*s*. 9*d*.	C. C. Ghosh . . .	Manager of Publications, Delhi.

APPENDIX XI.

List of Research Schemes of the Imperial Council of Agricultural Research in operation to which funds had been allotted up to the end of 1935.

Serial No.	Sanctioned Schemes.
	A.—Sugar Schemes.
1	Sugar Technologist and staff :— (*a*) Sugar Cable Service. (*b*) Construction and testing of improved juice boiling *bel.* (*c*) Indian Sugar Trade Information Service.
2	Grant to Shahjahanpur Research Station for a detailed examination of new seedling cane.
3	Grants to United Provinces, Bihar and Orissa and Punjab Government for experiments in designing of a satisfactory small power sugarcane crushing mill.
4	Bombay-Deccan Sugarcane Research Scheme.
5	Deputation of a Chemist to Bhopal to test Khan Bahadur Hadi's process of manufacturing sugar by open-pan method.
6	Grant to Harcourt Butler Technological Institute, Cawnpore, for sugar technology.
7	Scheme for the Establishment of a Sugarcane Research Station in Bihar and Orissa and for the appointment of a Sugarcane Specialist.
8	Scheme for the Establishment of a Sub-station of the Coimbatore Imperial Sugarcane Station at Karnal.
9	Scheme submitted by the Imperial Mycologist, Pusa, for research on 'Mosaic' and other cane diseases at Pusa.
10	Hadi's Commercial Test at Bilari under Lala Hari Sahai Gupta.
11	Bengal Scheme for Sugarcane crushing and *Gur* boiling.
12	Sugarcane Seedling Testing Station at Dacca.
13	Deputation of Sugar Technologist to Europe and America.
14	Grant to the Mysore Durbar for breeding of thick canes.
15	Economic enquiry into the cost of production of crops in the principal sugarcane and cotton tracts in India.
16	Chief Economist and his staff.
17	Research on the genetics of Sugarcane at the Imperial Cane Breeding Station, Coimbatore.

List of Research Schemes of the Imperial Council of Agricultural Research in operation to which funds had been allotted up to the end of 1935—contd.

Serial No.	Sanctioned Schemes.
	A.—Sugar Schemes—contd.
18	Research on Sugarcane in the Madras Presidency.
19	Establishment of a Sugarcane Research Station in the Punjab.
20	Investigation into various problems of sugar industry in the United Provinces.
21	Establishment of a Research and Testing Station for the indigenous system of *gur* and sugar manufacture by the Sugar Technologist to the Council.
22	Extension of Sugarcane work at the Jorhat Experimental Station, Assam.
23	Investigation into the production of *Khandsari* Sugar in the United Provinces and Bihar and Orissa.
	B.—General Agricultural Schemes.
24	Grant to Dr. K. C. Mehta for— (*a*) Investigation of rusts of wheat and barley. (*b*) Investigation into the Physiological forms of wheat rusts.
25	Botanical Sub-station at Karnal.
26	Grant to Dacca University.
27	Hemp Marketing Officer.
28	Investigation into the Vitamin Contents of Mangoes.
29	Professor Parija's Scheme of Water-hyacinth.
30	Professor Mukerjee's Scheme of Research into Properties of Colloid Soil Constituents.
31	Professor Mahalanobis' Scheme :— (1) Investigation on experimental errors in field trials. (2) Statistical Studies relating to agricultural work in India.
32	Dr. A. N. Puri's scheme of the standardisation of Physico-chemical single value measurements most suitable for Indian soils.
33	Grant to Principal, Agra College, Agra, for investigation into the rusts of wheat and barley.
34	Dr. Bhatnagar's Scheme :— (*a*) Effects of Ions on Plant Growth. (*b*) Physico-chemical properties and fertility of soil.

List of Research Schemes of the Imperial Council of Agricultural Research in operation to which funds had been allotted up to the end of 1935—contd.

Serial No.	Sanctioned Schemes.
	B.—General Agricultural Schemes—contd.
35	Professor Dastur's Scheme "Rice Physiology".
36	Dr. Chaudhuri's Scheme "Withertip of Citrus trees".
37	Establishment of a new branch of Agricultural Meteorology under the Indian Meteorological Department, Poona.
38	Grants to provinces for collecting data on manurial experiments conducted in the past.
39	Appointment of Physical Assistant on the staff of Agricultural Chemist, Bengal.
40	Co-ordinated scheme of Rice-Research in Provinces.
41	Award of a prize for a bone crusher worked by :— (*a*) Animal power. (*b*) Mechanical power.
42	Special Locust Research Staff.
43	Grant to Punjab Government for Locust Research.
44	Locust Bureau.
45	Experimental consignment of mangoes to the Empire Marketing Board.
46	Research work on potatoes in Madras.
47	Financial assistance to the Oil Technological Section of Harcourt Butler Technological Institute.
48	Investigation on the Organic Constituents of Indian Soils by Professor J. C. Ghosh.
49	Preparation of cheap synthetic manure from town refuse and waste materials by the Indian Institute of Science, Bangalore.
50	Investigation of the chemistry of malting cholam.
51	Extension of work on "Quality" in crops by the Indian Institute of Science.
52	Professor J. C. Seth's scheme for Investigating an electric method of Hygrometry.
53	Scheme of Malting and Brewing qualities of Barleys in the United Provinces, Punjab and Bihar and Orissa.
54	Grant to the Burmah Shell Oil Storage and Distributing Co., Bombay.
55	Enquiry into the supply of coconut products and coconut oil in India.

List of Research Schemes of the Imperial Council of Agricultural Research in operation to which funds had been allotted up to the end of 1935—concld.

Serial No.	Sanctioned Schemes.
	B.—General Agricultural Schemes—concld.
56	Statistical Section of the Bureau of Agricultural Intelligence.
57	Provincial scheme of fruit research, Bombay Cold Storage Fruit Scheme.
58	Horticultural schemes in the provinces of Madras, Bengal, Punjab, United Provinces, Bihar and Orissa.
59	Dry farming research scheme in the Bombay-Deccan, Hyderabad, Madras and the Punjab.
60	Improvement of castor crop in India by His Exalted Highness the Nizam's Government.
61	Headquarters Marketing Staff.
62	Potato breeding research in North India.
63	Tobacco Co-operative Experiments.
	C.—Animal Husbandry Schemes.
64	Testing of Drug Plasmoquine.
65	Investigation into the measure of control in existence for the prevention of adulteration of milk and other dairy products.
66	Mr. A. E. Slater's scheme of goat breeding.
67	Investigation of Indian Fish Poisons and other Indian Forest Products for their insecticidal properties.
68	All-India Legislation for the control of animal diseases.
69	Appointment of a Physiological Chemist to study animal nutrition at Dacca.
70	Appointment of Veterinary Investigation Officers in Provinces.
71	All-India Animal Husbandry Bureau.
72	Disease investigation officer, North-West Frontier Province.
73	Investigation into the most suitable and economic methods of combating different types parasitic infection in ruminants in the fields, etc.
74	Investigation of Johne's diseases among cattle in Mysore.
75	Extension of work on animal nutrition in Madras Presidency.
76	Appointment of a Statistician for the compilation of certain statistics relating to feeding scales, etc., in Military Dairies.
77	Investigation for vaccination of cattle against rinderpest.

APPENDIX XII.

Key to the Diagrammatic Map of Agricultural Stations.

Research Institutes and Agricultural Colleges	Special or Subsidiary Research Stations and Research Farms	Main Experimental Farms	Small Farms, District Farms and Demonstration Farms	Seed Farms	Major Cattle-breeding and Dairying Farms	Subsidiary Cattle-breeding Farms
1. Pusa (Bihar and Orissa)	1. Bangalore (Mysore). 2. Coimbatore (Madras). 3. Karnal-Botanical and Sugarcane Sub-stations (Punjab).		Imperial.		1. Pusa (Bihar and Orissa). 2. Karnal (Punjab). 3. Wellington (Madras).	
1. Coimbatore.	1. Berhampore. 2. Anakapalle. 3. Samalkota. 4. Meruteru. 5. Guntur. 6. Nandyal. 7. Hagari. 8. Anantarajupeta. 9. Gudiyatham. 10. Tindivanam. 11. Palur. 12. Aduturai. 13. Pattukottai. 14. Koilpatti. 15. Burliar. 16. Coonoor. 17. Kallar. 18. Nanjanad. 19. Pattambi. 20. Taliparamba. 21. Kasargod. 22. Pillicode. 23. Nileshwar.		Madras.		1. Hosur.	1. Guntur.
1. Poona.	1. Surat. 2. Nadiad. 3. Dhulia. 4. Dharwar. 5. Karjat. 6. Padegaon. 7. Sholapur (Dry Farming Res. Station). 8. Bijapur (Dry Farming Res. Sub. Station).	1. Ratnagiri. 2. Dhulia. 3. Jalgaon. 4. Surat. 5. Kirkee (Ganeshkind Fruit Exptl. Station). 6. Kirkee (Central Poultry Farm).	Bombay. 1. Kumta. 2. Mugad. 3. Gokak Canal. 4. Hatkhamba. 5. Mohol. 6. Kopargaon. 7. Broach. 8. Dohad. 9. Viramgam. 10. Kundewadi, Niphad (Wheat Breeding Station).	1. Bhadgaon.	1. Chharodi. 2. Bankapur. 3. Kirkee (Agric. College Dairy).	1. Tegur. 2. Surat.

			Sind.			
1. Sakrand. 2. Dokri.	1. Larkana.	1. Mirpurkhas.	1. Dadu. 2. Oderolal. 3. Lundo. 4. Padidam. 5. Nasirabad. 6. Shahdadkote.	1. Mirpurkhas.		
			Bengal.			
1. Dacca.	1. Berhampore. 2. Rangpur. 3. Krishnagar. 4. Chinsurah. 5. Bankura. 6. Rangamati. 7. Kalimpong.	1. Dacca. 2. Chinsurah. 3. Rajshahi.	1. Burdwan. 2. Berhampore. 3. Bankura. 4. Suri. 5. Krishnagar. 6. Jessore. 7. Gosaba. 8. Faridpur. 9. Rangamati. 10. Comilla. 11. Barisal. 12. Kishoreganj. 13. Mymensingh. 14. Pabna. 15. Dhanbari. 16. Bogra. 17. Jamalpur. 18. Rangpur. 19. Malda. 20. Dinajpur. 21. Mainaguri. 22. Charbadua.		1. Dacca.	
			United Provinces.			
1. Cawnpore (Agric. College). 2. Bulandshahr (Agric. School). 3. Gorakhpur (Agric. School).	1. Shahjahanpore. 2. Raya Muttra. 3. Cawnpore. 4. Nagina.	1. Gorakhpur. 2. Partabgarh. 3. Muzaffarnagar. 4. Jeolikote.	1. Benares. 2. Fyzabad. 3. Etawah. 4. Mainpuri. 5. Bichpuri. 6. Hardoi. 7. Bahraich. 8. Bulandshahr. 9. Nigohi. 10. Budaun. 11. Nawabganj. 12. Meerut. 13. Attara. 14. Hydergarh (Bara Banki). 15. Bara Banki. 16. Unao. 17. Kalianpur (Cawnpore.) 18. Kalai (Aligarh).		1. Muttra. 2. Kheri. 3. Bharari. 4. Hempur.	

Key to the Diagrammatic Map of Agricultural Stations—contd.

Research Institutes and Agricultural Colleges	Special or Subsidiary Research Stations and Research Farms	Main Experimental Farms	Small Farms, District Farms and Demonstration Farms	Seed Farms	Major Cattle-breeding and Dairying Farms	Subsidiary Cattle-breeding Farms
1. Lyallpur.	1. Risalewala. 2. Sirsa (Botanical Sub-Station). 3. Rohtak (Dry Farming Research Station). 4. Jullundur (Sugar-cane Research Station).	1. Lyallpur. 2. Montgomery. 3. Hansi. 4. Multan. 5. Jullundur. 6. Gurdaspur. 7. Kala Shah Kaku. 8. Rawalpindi.	**Punjab.** 1. Gurgaon. 2. Karnal. 3. Ambala. 4. Ludhiana. 5. Beas. 6. Kangra. 7. Ferozepur. 8. Gujranwala. 9. Gujrat. 10. Jhang. 11. Mianwali. 12. Campbellpur. 13. Attari.	1. Fatna. 2. Shergarh. 3. Vihari. 4. Risalewala. 5. Chillianwala. 6. Sargodha. 7. Multan.	1. Hissar.	
1. Mandalay		1. Maungmya. 2. Hmawbi. 3. Mudon. 4. Akyab. 5. Allanmyo. 6. Pyinmana. 7. Mahlaing. 8. Kanbalu.	**Burma.** 1. Paukkoung. 2. Sa-aing. 3. Kyaukpyu.	1. Chiba. 2. Kyehmon. 3. Singaing. 4. Pwinbyu. 5. Magwe. 6. Pyu. 7. Paungde. 8. Henzada. 9. Pegu. 10. Maubin. 11. Thaton. 12. Padu. 13. Nyaunglebin. 14. Pyapon. 15. Bassein. 16. Thegan Gwason. 17. Minbya. 18. Mingan. 19. Myingyan. 20. Zigon.	1. Tatkon.	
1. Sabour	1. Muzaffarpur (Sugar-cane Research Station). 2. Sabour (Rice Research Station).	1. Kanke. 2. Patna. 3. Sepaya. 4. Cuttack. 5. Sabour.	**Bihar and Orissa.** 1. Balasore. 2. Anandpur. 3. Puri. 4. Khurda. 5. Angul. 6. Purulia. 7. Gaya. 8. Neterhat. 9. Nawadah. 10. [illegible]		1. Kanke. 2. Sepaya.	

Key to the Diagrammatic Map of Agricultural Stations—concld.

Research Institutes and Agricultural Colleges	Special or Subsidiary Research Stations and Research Farms	Main Experimental Farms	Small Farms, District Farms and Demonstration Farms	Seed Farms	Major Cattle-breeding and Dairying Farms	Subsidiary Cattle-breeding Farms
	1. Baroda (Cotton root-rot research scheme).	1. Baroda. 2. Jagudan. 3. Amreli. 4. Vyara (cane farm).	**Baroda State.**			1. Makarpura.
1. Quilon.		1. Alleppey. 2. Koni. 3. Nagercoil.	**Travancore State.** 1. Alwaye. 2. Oachira. 3. Vaikom. 4. Kottarakara. 5. Puliyara. 6. Cape Comorin.			
1. Trichur.	1. Ernaculam.	1. Trichur.	**Cochin State.** 1. Thiruvankulam. 2. Trichur.		1. Trichur.	1. Ernaculam (Coconut Station). 2. Wadakkancheri. 3. Mulanthuruthy.
	1. Gwalior. 2. Ujjain.	1. Gwalior. 2. Ujjain.	**Gwalior State.**	1. Gwalior. 2. Ujjain.	1. Maharajpur, (Gwalior).	1. Maharajpur (Gwalior). 2. Ujjain.
		1. Shalabagh, Srinagar (Pratap Model Farm). 2. Jammu (Golsamandar).	**Kashmir State.**			
1. Nabi Bagh.			**Bhopal State.**			
1. Patiala, (Bhupindra Agric. Institute, Rauni).		Patiala (Bhupindra Agric. Farm).	**Patiala State.** 1. Bossi. 2. Hansa. 3. Dhuri.		1. Patiala (Bhupindra Dairy Farm).	
1. Indore (Central India, Institute of Plant Industry). 2. Ranchi (Bihar and Orissa, Lac Research Institute).	Nellacotta (Nilgiris, U. P. A. S. I.).	Sidapur (Madras, U. P. A. S. I.).	**Non-Official.** Borbhetta (Assam, Indian Tea Association).			

			Darbhanga. 13. Siwan. 14. Bikramgunj. 15. Siris. 16. Chianki. 17. Chaibasa. 18. Sambalpur.			
1. Nagpur.	1. Akola. 2. Raipur.	1. Powarkhera. 2. Adhartal. 3. Nagpur.	**Central Provinces.** 1. Chhindwara. 2. Tharsa.	1. Saugor. 2. Bilaspur. 3. Chandkhuri. 4. Drug. 5. Seoni. 6. Betul. 7. Khandwa. 8. Wara-Seoni. 9. Yeotmal. 10. Buldana. 11. Bergaon. 12. Sindewahi. 13. Dindori.	1. Telinkheri. 2. Raigarh (Garhi). 3. Pendra. 4. Ellichpur. 5. Bod. 6. Powarkhera 7. Ratona.	1. Richai. 2. Nagpur (College Dairy Farm).
	1. Jorhat. 2. Habiganj.	1. Karimganj. 2. Titabor. 3. Jorhat.	**Assam.**		1. Khanpara. 2. Sylhet. 3. Upper Shillong.	1. Jorhat.
1. Peshawar.		1. Tarnab. 2. Naurang Serai.	**North-West Frontier Province.** 1. Haripur. 2. Parachinar. 3. Derah Esmail Khan.			
	1. Quetta (Fruit Experiment Station).		**Baluchistan.**	1. Usta.		
1. Himayatsagar, Hyderabad.	1. Parbhani. 2. Raichur.	1. Sangareddi. 2. Warangal. 3. Rudrur.	**Hyderabad State.** 1. Mahbubnagar.		1. Himayatsagar, Hyderabad.	
1. Bangalore.		1. Hebbal. 2. Naggenhalli. 3. Hunsur. 4. Marthur. 5. Balehonnur (Head Quarters of U. P. A. S. I. Coffee Scientific Officer.) 6. Babbur.	**Mysore State.** 1. Chickanhalli. 2. Hassan. 3. Ramkrishnapur. 4. Singapur.	1. Mysore Irwin Canal Farm.	1. Ajjampur (Cattle-breeding Station). 2. Yellachi Halli (Sheep Farm).	